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# HMM

**SINGAPORE**

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TECH IN 2015**

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## SPY VS. SPY

That was one of the first video games I played and a franchise that I still remember to this day. I grew up watching James Bond, Impossible Mission and a different kind of Avengers. Before I knew about aliens, dragons, superheroes or galaxies far far away, I was going to grow up as a secret agent (or a ninja).

Well, we all know how that turned out. Still, helming a magazine has its privileges and I can indulge my fantasies every now and then.

We're at the end of another year of techno wizardry and while I can seem a little jaded at times, I am quite thankful I live in an age where one can readily get their hands on cool gadgets any spy would kill for 20 years ago. The spy genre

also seems to be undergoing resurgence somewhat with the Hollywood machine pumping out movie after movie from Kingsman to Spy to the latest James Bond vehicle, Spectre. So, of course we would dedicate this issue of HWM to all things spy worthy.

Forget cheerful Santa and a white Christmas, our team's curated a list of gear for the holidays that is fit for any spy wannabe. And it doesn't just stop with the annual gift guide, we have stories about taking down the internet, evasive driving and our own top secret report on the state of the tech industry in 2015.

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**Zachary Chan**  
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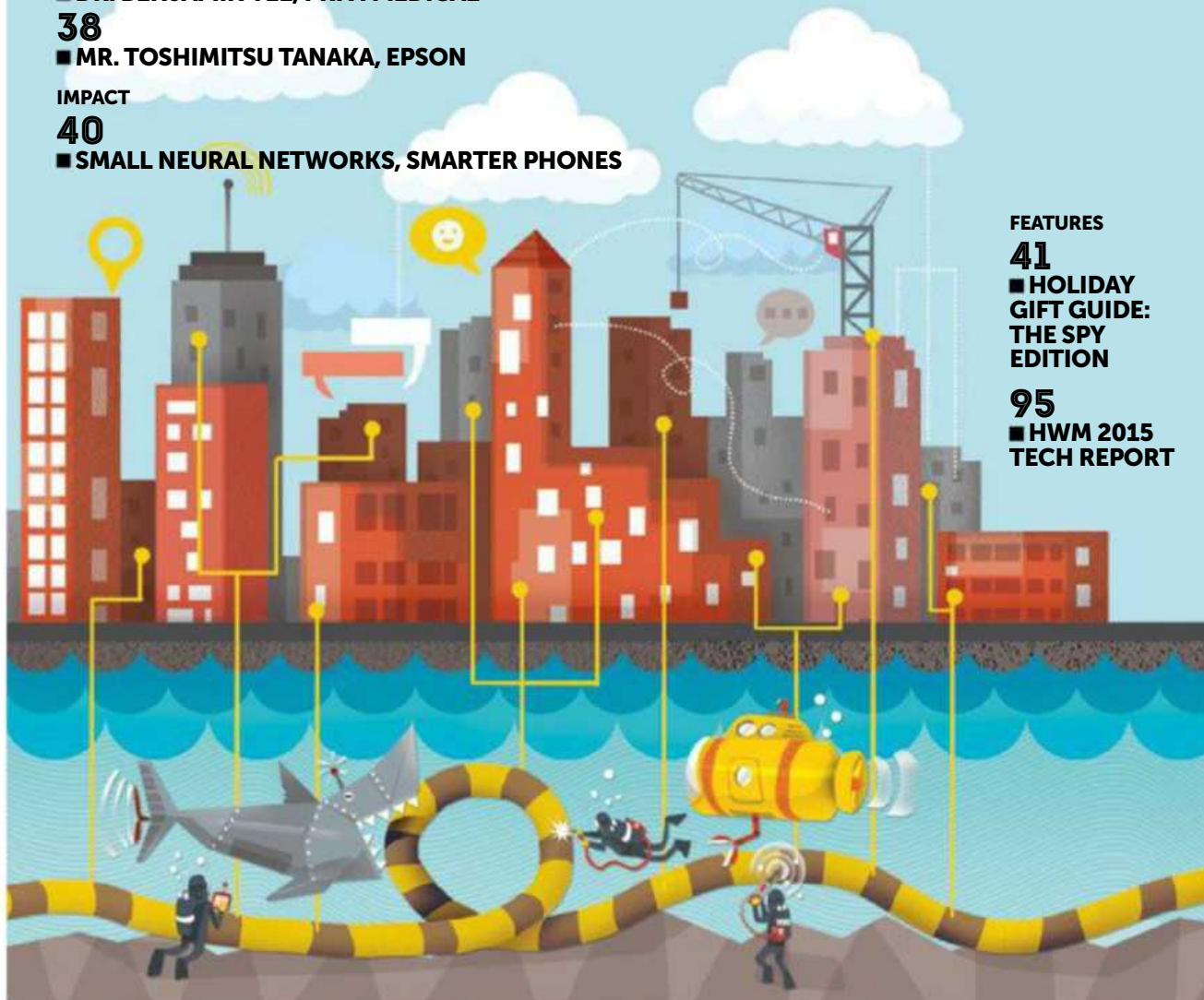
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ILLUSTRATION DON LOW  
ART DIRECTION KEN KOH

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**GROUP EDITOR-IN-CHIEF**

CAROLINE NGUI nguislc@sph.com.sg

**GROUP EDITOR**

RETA LEE CHOI WEI retalee@sph.com.sg

**EDITORIAL**

(editorial@hardwaremag.com)

**Editor**

ZACHARY CHAN zachchan@sph.com.sg

**Deputy Editor**

NG CHONG SENG csng@sph.com.sg

**Associate Editor (Creative Services)**

ALVIN SOON asoon@sph.com.sg

**Associate Features Editor**

JAMES LU jameslu@sph.com.sg

KENNY YEO kennyyeo@sph.com.sg

**Senior Tech Writers**

MARCUS WONG cmwong@sph.com.sg

**Tech Writers**

WONG CHUNG WEE wongcw@sph.com.sg

SALEHUDDIN HUSIN salh@sph.com.sg

KOH WANZI wzkoh@sph.com.sg

LIU HONGZUO liuhz@sph.com.sg

**EDITORIAL SUPPORT****Senior Manager, Administration  
and Editorial Support Unit**

JULIANA CHONG julianac@sph.com.sg

**Manager**

ALICE HAN tayaha@sph.com.sg

**Senior Editorial Coordinator**

MUNIRAH ABDUL RAHMAN munirahr@sph.com.sg

**CREATIVE**

(creative@hardwaremag.com)

**Associate Creative Director**

JAYSON ONG jaysono@sph.com.sg

**Art Director**

KEN KOH kenkoh@sph.com.sg

**Graphic Designer**

IAN CHONG ianchong@sph.com.sg

**Chief Photographer**

VERONICA TAY verontay@sph.com.sg

**Executive Photographers**

FRENCHESCAR LIM frenchl@sph.com.sg

TAN WEI TE tanweite@sph.com.sg

**Photographers**

DARREN CHANG darrenc@sph.com.sg

JASPER YU jasperyu@sph.com.sg

VEE CHIN veechin@sph.com.sg

VERNON WONG vernwong@sph.com.sg

WINSTON CHUANG wchuang@sph.com.sg

ZAPHS ZHANG teolc@sph.com.sg

**Photography Assistant**

CHERYL RAHARJO craharjo@sph.com.sg

**Editorial Support Executive**

JACQUELINE YIK jacyik@sph.com.sg

**MANAGING DIRECTOR**

DENNIS PUA dennisp@sph.com.sg

**GENERAL MANAGER**

PANG LEE CHENG panglc@sph.com.sg

**ADVERTISING SALES**

(sales@hardwaremag.com)

**Senior Account Manager**

FION YIP fionyip@sph.com.sg

MICHELLE TAN mtancl@sph.com.sg

**Account Manager**

JENNIFER TAN seowping@sph.com.sg

CHIA LAI SAN lschia@sph.com.sg

JACQUELINE LIEW jacqliew@sph.com.sg

**Account Executive**

LOUIS KOH louis koh@sph.com.sg

**MARKETING****Team Head**

VICKY YONG yongwmv@sph.com.sg

**Executive**

TEN HUI LING tenhl@sph.com.sg

**PUBLISHING SERVICES****Team Head**

ALICE CHEE siewyuen@sph.com.sg

**Team Leader**

LISA YONG lisayong@sph.com.sg

SPHmagazines

**CHIEF EXECUTIVE OFFICER**

LOH YEW SENG lohys@sph.com.sg

**STRATEGIC DEVELOPMENT DIRECTOR**

FOONG SEONG KHONG foongsk@sph.com.sg

**PUBLISHING SERVICES DIRECTOR**

LEONG TSCHENG YEE leongty@sph.com.sg

**CORPORATE COMMUNICATIONS HEAD**

CHIN SOO FANG soofang@sph.com.sg

**VICE PRESIDENT, HUMAN RESOURCES**

IRENE LEE leeb@sph.com.sg

**INTERNATIONAL LICENSING**

PANG LEE CHENG panglc@sph.com.sg

**INTERNATIONAL OFFICES****Indonesia Rep. Office**

Martin Wijaya (Chief Editor)  
JL. Palmerah Utara no. 55  
Jakarta Barat 11910  
Tel: (62) 21 5366 7777  
Fax: (62) 21 6220 2580  
Email: info.id@hwzcorp.com

**Malaysia Rep. Office**

Michael Low (Editor)  
Lot 7, Jalan Bersatu 13/4,  
section 13 46200 Petaling Jaya  
Selangor, Malaysia  
Tel: (60) 3 7952 7000  
Fax: (60) 3 7960 0148  
Email: sales.my@hwzcorp.com

**Philippines Rep. Office**

Marvin R. Velasco (Editor)  
Unit B-2, Topy Main Building, No. 3  
Economia Street, Bagumbayan,  
Quezon City 1110, Philippines  
Tel: (63) 2634 9179  
Fax: (63) 2634 9180  
Email: sales.ph@hwzcorp.com

**Taiwan Rep. Office**

Dennis Chou (Asia Media Contact)  
2F-2, No.35, Sec 2,  
Fushing South Road,  
Taipei 106, Taiwan  
Tel: 886-2-8773-4199  
Fax: 886-2-8773-4200  
Email: sales.tw@hwzcorp.com

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# NEW THIS MONTH

Every month, we receive dozens of product announcements and mentions, sit through many a launch event and try out all kinds of devices. All these products are then carefully curated by our crack team of tech gurus. The final list is presented here in Gear and it is our hope you'll find something to geek-out to.



## MORE INSIDE >

**MICROSOFT SURFACE PRO 4**  
Is this the one hybrid to rule them all?

**SONY XPERIA Z 5 PREMIUM**  
4K in your palm, literally.

**HTC ONE A9**  
Fruit or not, this one does music.

**FOSSIL Q FOUNDER**  
Smartwatch goes mainstream.

## LEICA S TYPE 007

No, the Leica S (Type 007) isn't a tie in with this year's James Bond movie. What is, though, is a radical upgrade for the series, with a new CMOS sensor and dual-core processor (the Maestro II) that allows the camera to produce images with a dynamic range of up to 15 stops with an ISO range of 100-12500. Truly a camera that's in a class of its own.



## SONY XPERIA Z5 PREMIUM

Sony has squeezed a 4K display with a resolution of 3,840 x 2,160 pixels into its newest 5.5-inch Xperia Z5 Premium smartphone, giving it a ridiculous 801 ppi. It also has a gorgeous chrome finish that's reflective enough to be a mirror, and a power button that doubles as a fingerprint sensor. And just like past Xperia Z flagships, the Z5 Premium is fully dust and waterproof.

## JBL FLIP 3

The third iteration of JBL's portable Bluetooth speaker is here. The Flip 3 is designed to have increased bass response, and it is splash-proof, thanks to the heavy-duty fabric its clothed in and port-sealing it comes with. These JBL cans come with a pair of 40mm drivers, and the ability to connect with multiple Flip 3 speakers to boost its sound levels even further.







## MICROSOFT SURFACE PRO 4

Intel's latest 6th-gen 'Skylake' Core processors, a 12.3-inch multi-touch display with 2,736 x 1,824 pixels, a new Surface Pen with 1,024 levels of pressure sensitivity - the Surface Pro 4 is all about refining the excellent and popular Surface Pro 3. Snap on an improved (but separately sold) Type Cover that features a more comfortable key set and trackpad, and you now have a powerful laptop that you can run your whole business on.

## AIBI SIXPAD ABS FIT

Ever wanted a six pack but stomach crunches aren't your thing? The Sixpad Abs Fit uses Electronic Muscle Stimulation to directly stimulate and exercise your abdominal muscles, leading to a better-shaped body. Slim enough to be worn under your clothes, you can "workout" on the move, or even at work.





## HP 34-INCH ENVY CURVED AIO PC

The 34-inch HP Envy Curved all-in-one desktop PC boasts of a 34-inch curved display with a whopping 3,440 x 1,440 pixels resolution. Equipped with Intel RealSense front-facing camera, the system supports face authentication with Windows Hello. Its graphics options include an NVIDIA GeForce GTX 960 plus an audio system tweaked by Bang and Olufsen's Tonmeister.



## HTC ONE A9

The HTC One A9 bears more than a passing resemblance to an iPhone. The 5-inch Full HD smartphone is powered by a Qualcomm Snapdragon 617 octa-core processor and comes with either 16GB or 32GB RAM.

Audiophiles will also be excited to learn that it has a built-in DAC that can upscale 16-bit audio to 24-bit, and helps power more demanding sets of headphones.





## UE BOOM 2

Ultimate Ears just updated their popular UE Boom speaker series - now boasting 25% louder audio with at a maximum sound level of 90dBA plus an extended wireless range of up to 30m. Like the first iteration, the new UE Boom 2 features 360-degree sound, with a wrap-around speaker designed to broadcast audio in every direction. It is still just as waterproof (IPX7) as before, and the UE Boom 2 still maintains the water bottle form factor.

## SHARP FP-FM40E

Sharp's new FP-FM40E air purifier is unlike any other. It uses HEPA and deodorizing filters to clear air, haze and remove clingy smells, plus Sharp's Plasmacluster technology that emits ions to replicate nature. The ace up its sleeves is that it also eliminates mosquitoes. Located at the intakes are UV lamps to attract mosquitoes. Once they get close enough, they get sucked in and onto a sheet of sticky glue.





## DJI OSMO

Want to take action videos on the go without shake? Then you'll want to take a look at the Osmo, DJI's camera-on-a-stick that comes with built-in 3-axis stabilization and integrated controls for easy freehand capture. The camera is capable of 4K video capture thanks to its 12.4MP 1/2.30inch Sony Exmor R CMOS sensor with an ISO range of 100-3200 - perfect for those run-and-gun videos!



## FOSSIL Q FOUNDER

The Fossil Q Founder is literally Fossil's first ever smartwatch. The traditional timepiece maker's first foray features an Intel processor and runs Android Wear, which incidentally, works with iOS 8.2 and up as well. Complete with a circular display and watch lugs, it blends classic analog timepiece design with digital smarts and customizable LED notifications.



### THE THUMB DRIVE WITH TWO BACKS

If you're looking for a painless way to transfer files between iOS devices, or even from a PC to your iPhone, look no further. Available in 16GB, 32GB, 64GB, and 128GB storage size options, the iShowFast has a read speed of 140MB/s write speed of 45MB/s on the USB 3.0 end. Its Apple Lightning connector side can go up to 30MB/s (read) and 20MB/s (write). iShowFast does not require charging, and it's an offline alternative to file transfers via cloud storage. For added protection, the iShowFast comes with password protection too. **iShowFast**



### A CULT FAVORITE RETURNS

The updated Razer Diamondback features all-new innards for 2015. It comes with a 5G 16,000DPI laser sensor, Chroma backlit side rails and scroll wheel, and up to seven programmable buttons. It retains the same long and slim ambidextrous form factor of the original Diamondback, complete with rubber side grips that will resist dirt and grime and provide an improved grip.

**Razer Diamondback (2015)**



### WHEN IS A SMARTPHONE NOT A SMARTPHONE?

When it supports Windows 10's Continuum feature that lets you hook it up to a monitor via an included desktop dock that turns it into a full Windows PC. One of the first Windows 10 phones around, the 5.5-inch Jade Primo has a Full HD display and is powered by a hexa-core Qualcomm Snapdragon 808 processor. In PC mode, the phone is fully capable of running Windows 10 apps and programs.

**Acer Jade Primo**

### CURVY GOODNESS

So you got a curved television in your living room, why not get a curved display for your desktop? Acer's new Predator X34 is a 34-inch curved display with a resolution of 3,440 x 1,440 pixels. It also features NVIDIA's G-Sync technology to reduce graphical lag, stutter and tearing. It also features a built-in 4-port USB 3.0 hub and accepts both HDMI and DisplayPort 1.2 inputs. **Predator X34**



### SIZE MATTERS

With a name like that, of course the Lenovo Phab is a phablet. It's actually one of the biggest phablets we've seen, with a huge 7-inch 1,280 x 720 pixels resolution display. This midrange "smartphone" also has a 64-bit quad-core chip, 1GB RAM, 16GB storage with microSD support up to 64GB, dual 4G LTE micro SIM card slots and Dolby Atmos technology built-in. **Lenovo Phab**



### BACK IN GOLD

With the release of Intel's newest sixth generation Core processors, ASUS has also updated its popular UX305 Ultrabook. Weighing a scant 1.2kg and measuring just 12.3mm thick, the UX305 now also comes in gold - great for the fashion-conscious. Inside, the UX305 is now powered by Intel's latest Core M3-6Y30 processor and also comes with 8GB of RAM and a 256GB SSD. **ASUS UX305 Gold**



### SING IN THE SHOWER

Who doesn't like some music in the bathroom? With the GoGear Splash n Dash suction cup splashproof speaker, simply place it next to a wall or shower screen and press down, and you'll have a speaker that will stream music from your mobile phone or computer via Bluetooth for up to eight hours. **GoGear Splash n Dash**



### LIGHTS GALORE

Compared to the original Hue, the new NZXT Hue+ lighting strip adds features like a smart lighting mode that reacts to changes in your CPU or GPU temperatures and gaming frame rates. A new audio mode also responds to your PC's audio output, so your system's lighting could pulse with every frag you make in game, or dance in time to your favorite tunes. Finally, the CAM software also lets you customize things like lighting direction and speed! **NZXT Hue+**



### WORLD-FIRST 165HZ DISPLAY

A quad HD monitor with a 165Hz refresh rate and an IPS display? The 27-inch ROG Swift PG279Q checks all the boxes. Despite its IPS panel, this ASUS monitor is speedy with a 4ms G2G response time. It comes with two USB 3.0 ports, a 3.5mm headphone jack, and HDMI and DisplayPort connectors. The thin bezel and LED-illuminated base give it a stunning aesthetic, and it also supports NVIDIA G-Sync for a smoother gaming experience. **ASUS ROG Swift PG279Q**



### THESE SPEAKERS COME TO PLAY

Jump in on the SG50 craze with these portable Bluetooth speakers from Nakamichi! The My Iwau speakers are IPX4-certified splash-proof and comes in a durable hard silicone exterior that needs little maintenance. Clip it to a stand, or hang it off a hook using the attached silicone strap and blast your tunes all day. **Nakamichi SG50 My Iwau**



### PORTABLE MOVIE PROJECTOR

The Lenovo Yoga 3 Pro is a tablet running Android 5.1 Lollipop and is powered by an Intel Cherry Trail Atom x5-Z8500 processor and has 2GB of RAM and 16GB of internal storage. If this all sounds normal to you, the Yoga 3 Pro has a trick up its sleeves. It also features an integrated pico projector that can project an image of up to 70-inches. Coupled with the built-in JBL sound bar, this makes the Yoga 3 Pro the ideal portable movie projector. **Lenovo Yoga 3 Pro**



### LG NEXUS REBORN

It appears that the smartphone was built with the popularity of the LG Nexus 5 in mind, but with updated specifications. The Nexus 5X is a 5.2-inch smartphone with a screen resolution of 1,920 x 1,080 pixels at 423 ppi on LCD. It uses a 64-bit 1.8GHz Qualcomm Snapdragon 808 hexa-core processor, paired with an Adreno 418 GPU for graphics, all powered by 2GB RAM. Like the Huawei version, the 5X comes with the latest Android OS 6.0, Marshmallow. **LG Nexus 5X**

PICTURES: ASUS, NAKAMICHI, LG, LENOVO

## SMARTER HEALTH

To address the number one complaint of its predecessor, the Microsoft Band 2 has a curved, 320 x 128-pixel AMOLED screen that better fits around your wrist comfortably. There is now a total of 11 sensors, including GPS, UV monitor, and barometer, so it can also do things like track your running and biking, plus record data like distance, speed, mapping, elevation, and personal bests. If you use Microsoft Health, you get actionable insights too. **Microsoft Band 2**



## PORTABLE PERFORMANCE

The Yoga 900 is an unabashedly performance-oriented hybrid. At just 14.9mm thin, it is the world's thinnest convertible to feature a sixth-generation Intel Core i processor. The signature watchband hinge looks wonderfully complicated, but it does allow you to fold the screen all the way around. In addition, the 13.3-inch IPS display packs a dense 3,200 x 1,800 pixels and the device supports up to 16GB of RAM. Photo and video editors, rejoice! **Lenovo Yoga 900**



## THE NEW STANDARD

Need a new lens for your weatherproof X-T1? The Fujifilm XF35mmF2 R WR is a standard focal length prime lens that has 9 elements in 6 groups with two aspherical elements for optimum image quality. The lens is also weather and dust resistant with an autofocus time of just 0.08 seconds, making it perfect for portrait, street or reportage photography. **Fujifilm XF35mmF2 R WR**



## THE FIRST PHONE WITH PRESSURE DETECTION

The Apple iPhone 6s was actually not the first smartphone with a pressure sensitive screen. That honor goes to Huawei's Mate S, which was announced about a week earlier. The 5.5-inch Mate S is Huawei's new flagship smartphone and is powered by a Kirin 935 processor, 3GB RAM and 32GB internal storage. Its Full HD display can register different levels of pressure, allowing for extra functionality, such as zooming into a photo with a stronger press. **Huawei Mate S**

# REDISCOVER THOSE SPECIAL MOMENTS

Canon's newest PowerShot G cameras make you fall in love with photography all over again.

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A high-definition electronic viewfinder (EVF) and vari-angle touch-screen LCD panel give you infinite possibilities for compositions. A large grip ensures a secure hold, and the camera's physical dials give you control at your fingertips. Like an EOS camera, you can also operate the control ring on the lens barrel.

**POWERSHOT G5 X - \$999**



## A STYLISH COMPANION FOR HER

The sophisticated Canon PowerShot G9 X is compact and light, making it easy to carry about, even in a lady's purse. This stylish camera is also powerful enough to capture the moments of your life in full detail, thanks to a large 1" sensor with a high resolution of 20.2MP, and a 3x optical zoom lens, all in a slim body that weighs only 209g.

Slip-proof, leather-like grips on both sides of the body give you a solid grasp of the camera, and you can operate the camera easily using either the 3" touch-screen LCD panel or the control ring around the lens. The G9 X has built-in Wi-Fi and NFC for you to upload and share your images via a smart mobile device. The svelte body comes in sleek black or silver with tanned brown trim, with elegant red highlights around the main dials.

**POWERSHOT G9 X - \$619**



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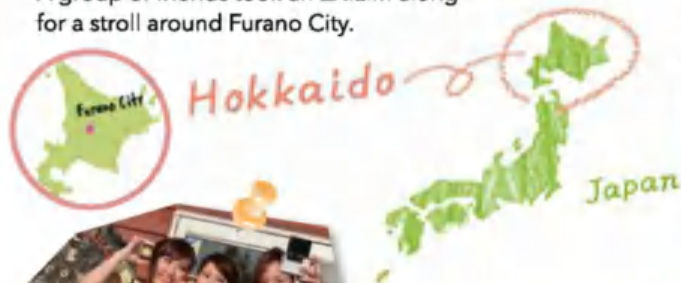
See the whole story here!



## Ladies Trip to Furano, Hokkaido!!

Furano City has all kinds of beautiful sceneries, most notably known for its fields of lavender, and is a popular spot for tourists, both homegrown and from abroad.

A group of friends took an EXILIM along for a stroll around Furano City.



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### AC750 CONCURRENT DUAL-BAND WIRELESS EXTENDER



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## GUESS THE CAR OF THE YEAR 2015!

Torque magazine, together with *The Straits Times*, will select the best new cars of 2015 in the collaborative ST-Torque Awards, which is Singapore's most authoritative editorial recognition of vehicular excellence.

The selection is based on a robust voting system that is the gold standard for local automotive awards, and the nine judges on the jury are the most respected in the industry, with over 150 years of collective experience in motoring journalism.

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*The Straits Times* Car of the Year 2015 will be revealed in the 2016 January issue of *Torque*. Grab a copy to find out if you have guessed correctly!



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THINK

# CAN ANYONE REALLY TAKE DOWN THE INTERNET?

With reports of Russia sending submarines and spy ships near undersea cables that carry most of the world's communications data, there are fears that Russia could bring down the Internet in times of conflict. Is that possible and what could be Russia's real agenda? by *Kenny Yeo*

## MORE INSIDE >

### THE TWITTER CONUNDRUM

Twitter's growth is stagnating and its biggest problem is likely its biggest feature as well. How will the company turn things around?

### THE EVOLUTION OF PRINTING

Epson's Toshimitsu Tanaka talks to us about the future of putting ink on paper.



# NO SINGLE ENTITY CAN BRING DOWN THE WWW

But it's possible to cripple it momentarily.

In late October 2015, it was reported that there were heightened levels of activity by Russian submarines and ships along routes carrying vital undersea cables, leading to growing concerns by the United States government that Russia could be studying or even planning to attack or cut these cables during times of tension or conflict.

These fears are very real given the recent state of affairs surrounding Russia and United States relations. The two nations have had a tense history, but matters took a turn for the worse following the Ukrainian Crisis of last year. And relations became even more bitter after Russia decided to pledge support for president Bashar al-Assad of the Syrian government, against the United States' demands that Assad leave power. As a result of these provocations, relations between the two superpowers have dipped to levels unseen since the Cold War.

According to a New York Times report, it said "The ultimate Russian hack on the United States could involve severing the fiber-optic cables at some of their hardest-to-access locations to halt the instant communications on which the West's governments, economies and citizens have grown dependent."

This is a view echoed by some of the United States' most senior military officers. Rear Admiral Frederick J. Roegge, commander of the Navy's submarine fleet

"The idea behind ARPANET ensured communications wouldn't be severed even if nodes were taken down. With that in mind, cutting a single data cable, even a major one is unlikely to have significant impact."

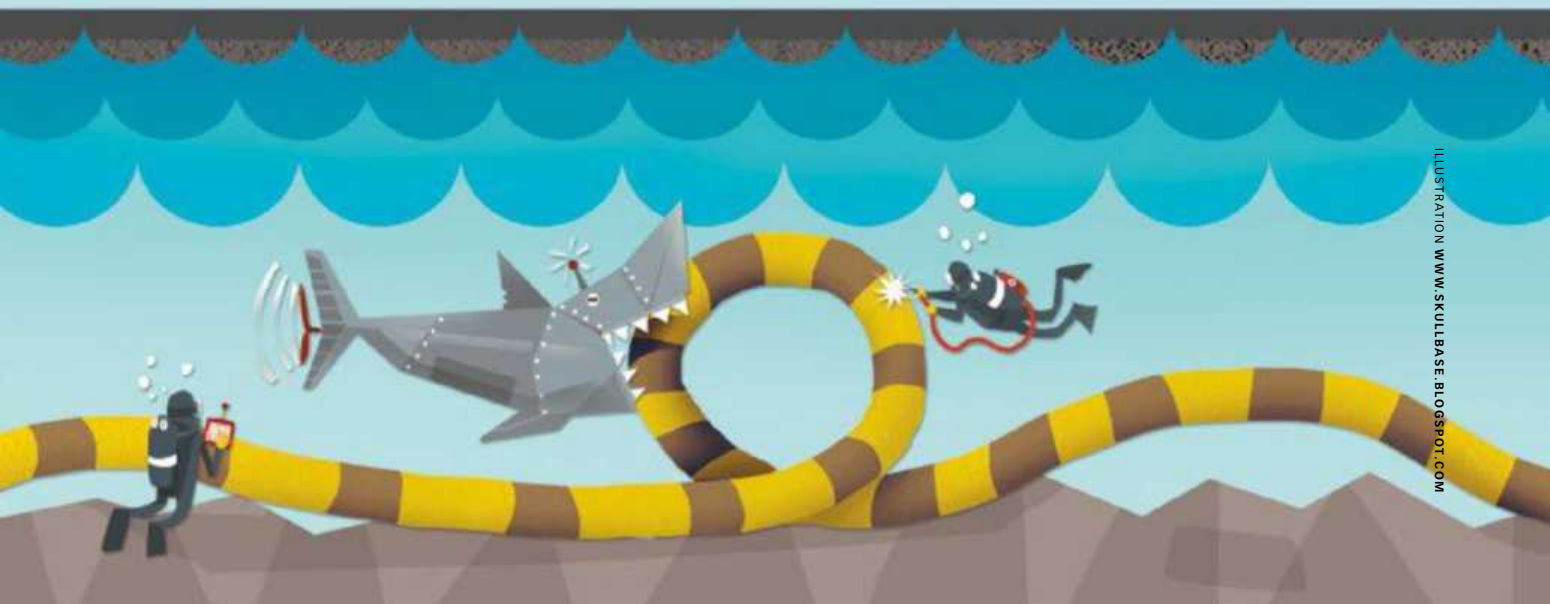
in the Pacific, said, "I'm worried every day about what the Russians may be doing."

But the question remains, "Can Russia really take down the United States' access to the Internet?"

The short answer is that it is highly unlikely. For that we have to visit the origins of the Internet. The Internet that we know today is a network of networks consisting of billions of devices and countless numbers of nodes and servers. It was birthed from ARPANET (Advanced Research Projects Agency Network), an early network designed to showcase packet switching and TCP/IP technologies. Although the reasons for ARPANET's development are hazy, it's generally agreed that the network was designed primarily for survivability in the events of attack and for military communications.

The idea behind ARPANET ensured communications wouldn't be severed even if nodes were taken down. With that in mind, cutting a single data cable, even a major one is unlikely to have a significant impact on United States telecommunications.

In an interview with Nicole Starosielski, Assistant professor of media, culture, and communication at New York University, and author of the book *The Undersea Network* (Duke University Press), and she said that these undersea cables are actually frequently damaged, as often as once every three days, by



natural occurrences like storms and tremors, and even mundane items such as fishing nets and ship anchors.

She went to clarify that even if numerous cables were significantly damaged, the Internet is resilient enough to reroute data. Here's an example. In the 2011 Tohoku earthquake and tsunami, which severed a number of undersea cables, Japan's ability to connect to the Internet was largely unaffected because of the large number of other connections that the country has. However, she also noted that if a country only has limited connections, then a single break could be potentially disastrous. Starosielski cited the 2006 Hengchun earthquake as another example, which damaged cables near Taiwan and disrupted businesses in Taiwan.

This leads to the next question, "How many cables does the United States have in total?" Tim Stronge, researcher at TeleGeography, which tracks the commercial submarine cable industry, said that there are about 15 running out from the east coast of the United States to Europe, and to Central and South America, and many more running out from the west coast to Asia. To effectively disrupt United States telecommunications would require

a massive task force of submarines to cut all cables in unison.

Given the United States' military clout, that is unlikely to happen, but what if it

**"In the 2011 Tōhoku earthquake and tsunami, which severed a number of undersea cables, Japan's ability to connect to the Internet was largely unaffected due to the large number of other connections the country has."**

does? "Let's say some foreign entity, some evil doer, like a James Bond villain, cuts every single undersea fiber-optic cable connection to the United States," says

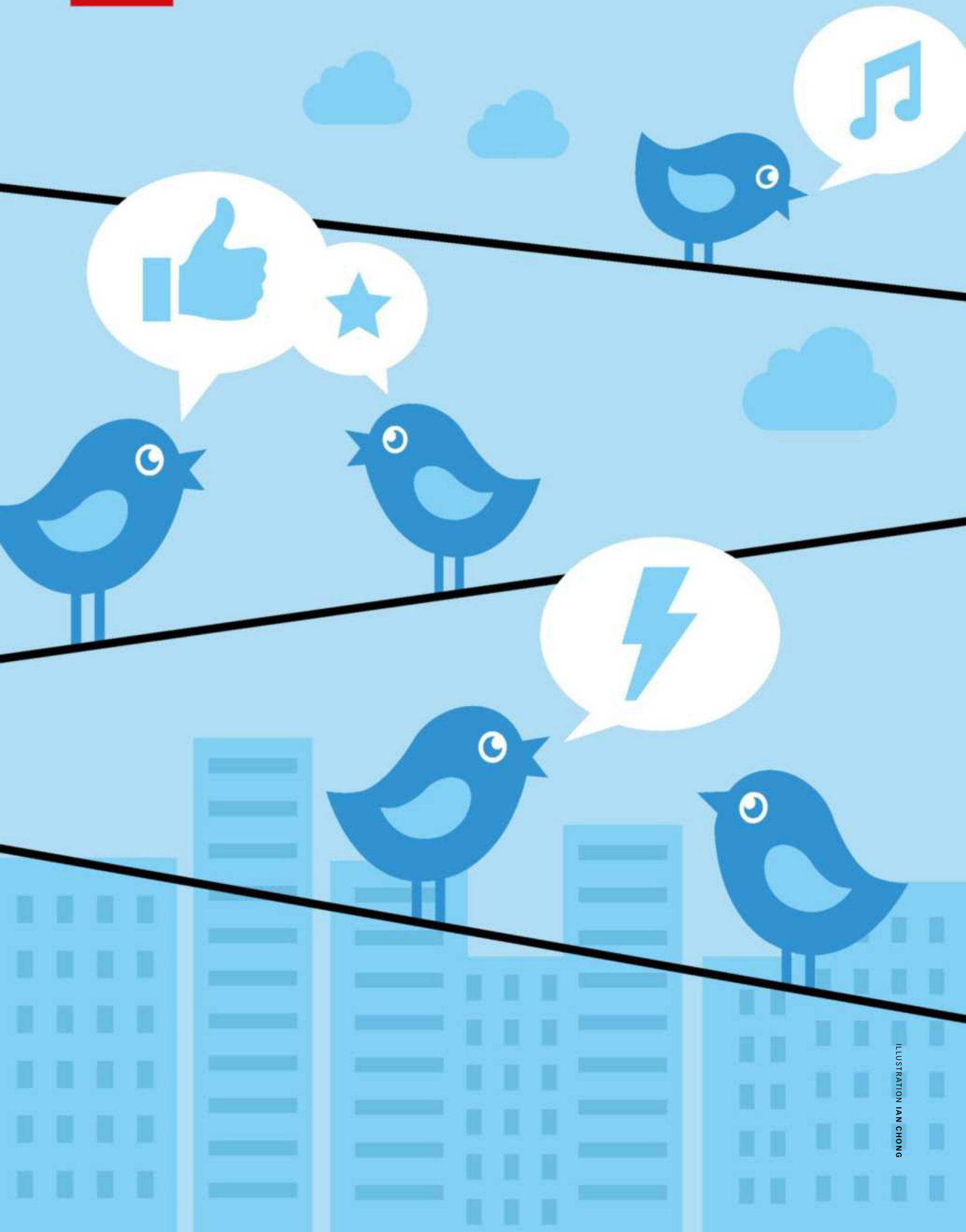
Stronge, "well, we do still have satellite."

Additionally, let's not forget also that the United States is arguably the most important node in the Internet, and severing all connections to it would also disrupt connection to everyone else, including Russia themselves, limiting their own capabilities. In other words, it's kamikaze and unlikely to be the motive behind Russia's recent actions.

The real worry is that the Russians are in fact searching for secret cables that are carrying classified military details and intelligence. Unlike other undersea cables that carry the world's Internet traffic, these cables are unmapped. And if found, the Russians could tap into these cables to steal valuable information. This could then force the United States to use less secure means of communication, which in turn puts this valuable information at greater risk of being compromised.

It is said that Russian espionage in the past years have reached Cold War levels and with the United States set to elect a new President next year, all eyes will be on the new President and it will be intriguing to see what measures he or she will undertake, for it will surely have a profound impact on the rest of the world.








# WHAT IS TWITTER'S PROBLEM?

Maybe people just don't care for Twitter anymore.

by Koh Wanzai

 Tweet, tweet. Is that the sound of birds at a new dawn, or rather the valiant peeps of Twitter's familiar blue bird, trying not to get snuffed out by Facebook and Instagram?

It's common knowledge that Twitter is struggling. After swapping head honchos – Costolo is out, Dorsey is back in – the company announced that it would cut around 8% of its global workforce in a bid to create smaller and nimbler engineering teams that could react faster. There was also talk about streamlining the organization, clearly part of an effort to give the impression that Twitter was making itself anew.

And boy, does it need to. With around 320 million active users, Twitter trails Facebook's 1.4 billion users by a large margin. It's even behind Instagram, which came onto the scene only in 2010 (Twitter will be 10 next July). In October, Twitter released figures showing that not only had it gained a measly four million active users that quarter, none of them were even from the US!

## No direction

Earlier that month, Twitter also launched a brand new service called Moments, a content discovery tool of sorts that allowed users to follow curated, real-time updates on ongoing events like the Oscars, a sports game, or even breaking news. This was supposed to be Twitter's big gambit, a feature that would help it reinvigorate its existing user base and attract new users.

But frankly, Moments sounded like a rather bland feature to us, if not just a not-so-subtle attempt to get people interested in the stuff floating around on Twitter. And then there were polls, which allowed users to post questions that could be answered with either a yes or no. On top of that, Twitter was reportedly experimenting with a news tab that would show users trending stories from major news outlets.

Taken individually, these aren't bad ideas at all. But put them together, and the overall impression is that of a company that doesn't appear to have a clear idea of how to appeal to new users. There appears to be a focus on news, but then again everyone is focusing on news – just look at Facebook's Instant Articles and Snapchat's Discover. On the topic of content discovery, even Instagram experimented with a curated video channel on Halloween, a possible prelude to a future feature that would serve up real-time videos related to the event at hand. If anything, that just sounds something like a video version of Moments.

## The best parts of Twitter are also its worst

Twitter's 140 character limit and reverse chronological feed is unlike anything else offered today. It surpasses even Facebook as a platform for amplifying social issues and raising awareness

about key movements of the day. After Michael Brown's shooting in Ferguson in the US, "#Ferguson" started trending strongly on Twitter, but the hashtag was virtually lost in Facebook's algorithmic filters.

Furthermore, the brevity of each tweet is such that they feel more raw and authentic than anything posted on Facebook. Facebook posts are arguably more carefully crafted, with users spending more time on each post, and often posting things after the fact. On the other hand, Twitter's character limit fosters a more rapid, staccato burst of thoughts, and tweets can essentially become the literal stream-of-consciousness of the masses.

The problem is that Twitter has been inching perilously close to losing its identity. Attempts to ape competitors – remember the overhauled profile page that suddenly looked a lot like your Facebook profile? – have only exposed it to derision and failed to generate enough interest to rope in new users. And as Robinson Meyer pointed out in an article for The Atlantic, Twitter simulates face-to-face conversation, perhaps because of its casual, off-hand nature, but tweets have ended up being taken as seriously as

official statements. Just think about how many public figures have taken flak for a poorly worded tweet, or simply one that was taken out of the context of the moment.

As a result, Twitter finds itself in perpetual conflict with the nature of online discourse in the digital age. More suited as a vehicle for spontaneous conversations and thoughts, Twitter is being treated as if a whole lot of gravity went into composing tweets. This exposure to harsh scrutiny

takes away some of the appeal of the service. Tweets call for a certain levity, but we've been taught that on the Internet, nothing ever really goes away. Because users are unable to reconcile the disjunction between what Twitter appears to encourage and the long memory of the Web, they may prefer platforms like Facebook and Instagram. You feel more justified in taking longer to post a status to Facebook, and Instagram is nothing if not a carefully choreographed slate of photos.

No one appears to have a prescription for what ails Twitter. But maybe the problem lies not with the network, and rather the milieu that has grown around it. The qualities that make it unique are also the very ones that are dragging it down. The last thing we need is another Facebook, and Twitter cannot change its core product without alienating its current users. The future looks uncertain at best, if not downright bleak. Perhaps Twitter will become the platform of society's margins, which would actually be a fitting outcome given its record as a tool for rallying support for various social causes. Twitter is a great product, but one that is subject to unfortunate cultural headwinds and out-of-sync with the majority of its audience.

"The qualities that make it unique are also the very ones that are dragging it down."



I truly feel that  
the next big  
breakthroughs  
will come from  
the ability to  
mimic biological  
systems very  
well.





# Nature is the greatest engineer

DR BENJAMIN TEE,  
CO-FOUNDER, PRIVI MEDICAL

by *Marcus Wong*

## **E-skin sounds like something from the movies. What made you start working on it to begin with?**

As a kid I was always a big science fiction fan, and I loved Star Wars a lot. For some reason the scene where Luke Skywalker's hand was replaced by a robot after it got cut off always stuck with me, and that might have affected my decision to go into this field.

Moving on to my PhD, I was interested in frontier research and was working on organic electronics at the time, focusing on the ability to detect force, just like how Luke's robotic arm could detect a pin prick. Towards the end of my PhD, I started working on the ability to self-heal, which was really an Eureka moment for me. I had cut myself accidentally while cooking lasagna and at that moment, it occurred to me that nobody has made electronic skin that can heal itself; just like how my skin can heal the cut.

Researching more into it; of course skin heals itself by regeneration. Plastic materials won't regenerate as they are non-living, so we worked with material scientists and chemists to develop this technology. Our self-healing skin can heal itself without a lot of energy. You just place them mechanically together and the chemical bonds will act like nano-zippers to "zip" the cut up.

## **That really sounds like something from out of the movies. How do you move on from there?**

I'm actually starting on a new paper to tackle creating artificial receptors which will send pulses to your brain

just like our natural receptors do. I like to think of it as biologically inspired research, and I truly feel that the next big breakthroughs will come from the ability to mimic biological systems very well.

After all, nature has used millions of years to create the sophisticated systems in our bodies and these systems can do things a thousand times better than anything we've created. First we have to understand them, then we can try to mimic them. I think now we have the tools to do that.

Along the way, I'm sure technologies will be discovered that can be applied to other avenues of science, which is why we need to take a multidisciplinary approach. There are just so many secrets nature can reveal, but we'll need a sense of collaboration and a willingness to share to fully explore them. I have no doubt the future is in multidiscipline.

## **Sure. But how do you get these experts from other disciplines to work with you?**

It's very important to do early reading before you meet these experts so you can have a meaningful discussion with them. You have to be comfortable with being uncomfortable, and learn terms you may not yet understand. But you have to also know your own field of work really well so you know what you can offer them in return.

Maybe the Government has to incentivize people to do more cross-disciplinary research too, but at the same time I think we're still working mostly on a "technology

push" approach, where we develop technologies and try to find applications for them.

After I graduated, I realized I wasn't seeing my research translated into products quickly. Conversely, at the Stanford program we learnt to take the opposite approach – to see what the problems are first. This ties in nicely with design thinking and the lean start-up movement; and is more of a "technology pull" approach.

## **What's the greatest advantage of this approach then?**

I think a lot of times as engineers we tend to just come up with solutions first, but most of the time it doesn't work because what the customer needs is usually not very obvious. I decided I needed to create a hybrid process where I could develop technology both ways so you create solutions that are readily needed but at the same time not lose the forest for the trees.

For example, when you have cancer now, what do you do? Drugs are not so great and chemotherapy is very harmful. But what if you have nanorobots that can swim in your body and detect cancer? That could completely eradicate cancer – without surgery.

But all these elegant solutions often have many failures before them. We need to know that an idea is always a diamond in the rough when it first comes out, so we need to polish it, to keep showing it to people until we get it. Technology and science are really just tools to allow us to do greater things, but it's really up to us to say we want to do this for the benefit of mankind.



# The evolution of printing

MR TOSHIMITSU TANAKA,  
MANAGING DIRECTOR OF EPSON'S  
REGIONAL OFFICE

by *Marcus Wong*

## How would you say printing has evolved through the years for both businesses and individuals?

We've found that consumers are still asking for improvements like wireless printing and the ability to print direct from mobile.

People now want for the entire household to be able to connect to the one printer, and that printer should also be able to do things like Cloud printing as that becomes more common. The most commonly printed items now are actually things like maps and photos from their mobile phones, so being able to print direct from their mobile phones is very important to them.

As for businesses, cost effectiveness and productivity has always been the main concern. Companies are still looking for solutions that provide better speed and durability, as well as new features such as duplex printing.

In the industrial space, we are seeing rapid growth for printing solutions for items like labels and textiles that require fast turnaround and high mix, low volume production. We also see a growing market for the use of customized packaging and labelling, be it to test out specific products or to meet regulatory requirements, so our printers have to change to fit those needs too.

## With the advent of digital, how do you think consumer printing habits have changed?

The nature of what and how people are printing is changing – people are increasingly printing content directly from their mobile devices such as Internet pages, maps, photos and more. Consumers are also printing less due to the penetration of the Cloud and social media becoming

mainstream.

But while print demand is declining in some areas, we believe that if you provide good convenience, people will still keep printing. And certainly they still have to do so for school reports and for photographs.

The impression of holding a photographic print is completely different from just seeing the image on screen. I can't speak for today's generation, but I can say for myself that I clearly get a sense of feeling from prints that I don't get from just the screen. There's just so much better tone and clarity in a print that you get a completely different impression of a photo when you hold it in your hands. So, I believe that printing will continue even in the future.

## Do you think we've seen the best of printing technologies already?

I think printing technologies still have a lot of room to improve. For example in terms of printing speed, connectivity, expandability, the type of inks we can use...I think we can expect to see a lot of developments to come, and I believe Epson will be behind many of these innovations.

## How so?

Well for example, Epson's Micro Piezo Print head technology enables scalability, which enables Epson to address a diverse range of print applications across different segments, to commercial and industrial printing involving large format printers for textiles and labels. Improving our low volume digital printing and "print on demand" services will also definitely be beneficial to SMEs looking to expand their commercial printing capabilities.

As a leader in printing solutions,

we would also want to promote the use of prints to inspire creative industry talent to express themselves more freely. With our technology, they can bring prints to life with the peace of mind that their visions can be replicated with industrial-level precision.

## Let's talk about the new wearables from Epson – the RunSense and the PulseSense. What was the thinking behind those?

Well, these fall along Epson's ideology of "Creating a better personal life".

Epson's range of wearable technology, from smart glasses to heart rate and activity monitors, is designed for smarter living and training. We're trying to improve quality of life by producing a range of products that use the precision sensors we have created by pairing our semiconductors with our QMEMS and other crystal device technologies to provide support for fulfilled and affluent lifestyles.

Through these devices, we aim to improve the quality of life for consumers, as they can be applied to fields such as sports, personal healthcare, and industry to monitor the health and safety of people and infrastructure.

For example, the RunSense has a built-in position sensor (GPS) for sports, and our PulseSense heart rate monitors have built-in pulse sensors and track your activity. This allows them to collect accurate data on your activity, biological measurements such as heart rate, and GPS position.

As print, projection and display needs change, we respond with products that break through the barriers of what is currently possible - so that you can see a brighter, smarter future.

“

**We believe  
that if you  
provide good  
convenience,  
people will still  
keep printing.**

”



# SMALL NEURAL NETWORKS, SMARTER PHONES

by Koh Wanzi

■ As it turns out, it's not just the human brain that is worth modelling. Researchers at IBM have created a compact system modeled after the 48 million nerve cells in the brain of a small-sized rodent. By mimicking the network of neurons and synapses in a living brain, computer systems and algorithms can be fed data and learn to perform specific tasks.

While deep learning technology is already available in the form of Facebook's face recognition feature and Skype's real-time translation service, IBM's chip could allow smaller devices like smartphones, hearing aids, and even watches to harness the technology and related algorithms more effectively. In the case of Google Now, most of the computing takes place on Google's servers, which means they're inaccessible if you happen to be working off the grid.

However, IBM chips, which have been dubbed TrueNorth, open up the possibility of moving at least some of the processing left onto phones and other personal devices. A single TrueNorth chip contains 5.4 billion transistors, but draws only 70 milliwatts of power.

So while a company like Google could train neural networks in its own data centers to recognize say, pictures of cats, the smaller-scale neural network on your phone would build off this capability and simply help to execute it.





FEATURE

# GIFT GUIDE FOR SUPER SPIES

Stuck for a holiday gift for the spy movie fan in your life? From tiny drones to spy watches to indestructible flash drives, here's a list of cool gadgets that even James Bond will be proud of.

Text by *Team HWM* • Art Direction by *Ken Koh*



ILLUSTRATION 123RF.COM / NEVRO2008 ART DIRECTION KEN KOH



# STEALTH

## FOR NIGHT MISSIONS

### SELECT YOUR GEAR

#### 1. APPLE WATCH (SPACE BLACK)

Sadly the Apple Watch won't emit a high-powered laser beam, but it is the ultimate smartwatch for any secret agent. Put your iPhone in a discrete location and use the Apple Watch to monitor its video feed. You can even take pictures remotely to capture any incriminating evidence. You can also discretely tap out morse code messages with its Digital Touch messaging feature, or use it to send your heartbeat to HQ to ensure them you haven't been captured and eaten by any sharks with laser beams attached to their head.

[www.apple.com](http://www.apple.com)



#### 2. MICRO DRONE 3.0

The palm-sized Micro Drone 3.0 is the essential companion for capturing covert footage thanks to its on-board HD video camera. Footage from the camera can be streamed back to your smartphone, which then doubles up as a display to let you see where you're flying. The drone also has a number of computer-assisted features including auto-leveling via intelligent motion sensors, the ability to fly in winds up to 45mph thanks to corrective algorithms, and an inverted flight mode made possible by motors that can reverse their polarity. And of course it comes in stealth black.

[www.extremefliers.co.uk](http://www.extremefliers.co.uk)



#### 3. SONY A7S II

You've got a mission, it's completely dark, and you can't even see your own hands? Don't worry, because while you can't see, the Sony A7S II can. It has an astounding ability to go up to ISO 409,600, which lets you shoot pictures of things you don't even know are there. It's compact but still packs a large, full-frame image sensor. Next time you need to get some espionage done, pack the Sony A7S II.

[www.sony.com](http://www.sony.com)





4.

#### STEALTH WEAR

Thanks to cheap cameras, mobile devices, the Internet, and now, drones, it's getting increasingly hard to balance security and privacy. Stealth Wear is a collection of garments designed to thwart surveillance - more specifically, thermal surveillance from unmanned aerial vehicles. From a hoodie to a scarf, these anti-thermal imaging clothes (mostly with silver-plated exterior) are stylish enough that you can literally stroll home in them after a successful night op, and no cops who you bump into along the way will suspect a thing.

[www.ahprojects.com](http://www.ahprojects.com)



5.

#### OUTLIER ULTRAHIGH BACKPACK

This is the backpack ninjas would have worn back in the old days. Not just because it comes in midnight black, but also because the Ultrahigh Backpack from Outlier is made of what they call Ultrahigh Nonwoven Composite. Built using Ultrahigh Molecular Weight Polyethylene fibers that are stronger than steel yet float on water, this is one incredibly light backpack that is incredibly strong.

[www.outlier.cc](http://www.outlier.cc)





# OUTDOORS

## FOR HARSH ENVIRONMENTS

### SELECT YOUR GEAR

#### 1. OLYMPUS TOUGH TG-4

When it's you versus wild, you'll need a camera that can keep up with you. But the Olympus Tough TG-4 isn't just tough, it's also a really good camera. It's waterproof, crushproof, shockproof and freezeproof, rugged enough to go anywhere you'd dare. It also has a high-speed f/2.0 lens, with a 16MP BSI sensor and raw capture, Wi-Fi for wireless sharing and GPS for geotagging.

[www.olympusimage.com](http://www.olympusimage.com)



#### 2. SONY X1000VR 4K ACTION CAM AND LIVE-VIEW REMOTE

You never know where the mission will take you sometimes, so a good spy brings a camera that will go anywhere and handle any sort of conditions. In your case, that's the Sony X1000VR 4K Action Cam, which is dustproof, shock proof, and can go up to 10m deep underwater with the supplied SPK-X1 case. Of course, there are going to be times when you'll want to hide the camera for remote recording, and that's where the included Live-View remote comes in handy. A single unit will control up to five cameras and you can live stream the footage back to HQ so our analysts can get you feedback in real time.

[www.sony.com](http://www.sony.com)



#### 3. OAKLEY AIRWAVE 1.5 SNOW GOGGLES

When you asked for a change of scenery, you probably didn't know that you'd get a reconnaissance mission in the heart of the Alps. Either way, be sure to take along the Oakley Airwave 1.5, a pair of augmented reality snow goggles that projects useful information on a nifty heads-up display. With built-in GPS and maps, you'll always know your precise location. If you're going with your team, it also has buddy tracking features, so everyone will always be accounted for. What's more, it can sync with your smartphone so you're always in touch with the latest intelligence from headquarters.

[www.oakley.com](http://www.oakley.com)





4.

#### SONY XPERIA Z5

If you're trekking through the rain and snow, across rivers and lakes, there's only one smartphone you should consider, the Sony Xperia Z5. Rated IP68, the Z5 is practically impervious to the effects of water and dust. The Z5 also boasts great battery life so you don't need to worry about it dying on you, and has a lightning-fast fingerprint scanner for additional security. If you need any more convincing, the Z5 is also the official phone of James Bond in Spectre.

[www.sonymobile.com](http://www.sonymobile.com)



5.

#### DELL LATITUDE 12 RUGGED TABLET

You can literally use this tablet as a blunt weapon when you go storming through the doors of your nemesis' Antarctic fortress. The 12-inch tablet has been designed to military-standard requirements and tested under the harshest conditions. Its display is designed to be readable even under direct sunlight and will respond even while wet. In addition, it can withstand dust and water, humidity, and high altitudes, so you can literally take this anywhere. Sturdy, rubberized corners and a tough shell protect it against drops, while the Intel Core M processor and 512GB SSD hum along without missing a beat.

[www.dell.com](http://www.dell.com)



## CORPORATE ESPIONAGE MUST HAYES

## SELECT YOUR GEAR

If you've ever tried to take notes on a regular smartphone's on-screen keyboard, you'll know how frustrating it can be. And if you need to be in and out in mere seconds, forget about it. Fortunately the Note 5's S-Pen stylus makes jotting down notes a breeze - you don't even have to waste time unlocking the phone, you can write on the standby screen! And if you need to take location photos on a covert site recce, it's easy to add notation to those photos later. "Security guard leaves spot every 60 minutes for donut break."

[www.samsung.com](http://www.samsung.com)



Got a mission to infiltrate the bank? You need to blend in and dress the part, and that means looking like a banker. These bankers are all about watches and there's no better watch for the job than the Omega Seamaster 300 "Spectre" Limited Edition. Yes, it's an Omega, so no one is going to laugh at you for wearing a cheap watch. Better yet, this particular watch is the very same one that Daniel Craig will be wearing as James Bond in the latest Spectre movie. It's handsome, tough, highly accurate and totally dependable. But more importantly, if it's good enough for Bond, it's good enough for us.

[www.omegawatches.com](http://www.omegawatches.com)

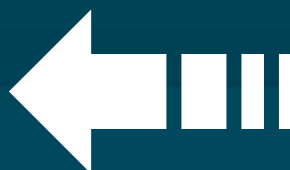


What better way to do surveillance in the office than to sneak a camera into the ubiquitous thumbdrive? This USB stick camera by Thanko looks like any other thumbdrive, but hides a video camera that measures just 1mm in diameter. The thumbdrive itself is only 50mm long and 12mm tall, making it extremely portable. And there's even an internal battery so you can use the camera without having to plug it in to a computer - definitely handy for stealing a few quick snaps of official documents before anyone notices.

[www.thanko.jp](http://www.thanko.jp)



PICTURES SAMSUNG, OMEGA, THANKO, KINGSTON, APPLE







#### 4. **KINGSTON DATATRavelER 4000 G2**

No data is safe on a flash drive unless you encrypt it. But not any type of encryption, mind you. Encased in titanium coated stainless steel, the Kingston DataTraveler 4000 G2 is protected by hardware-based 256-bit AES encryption in XTS mode and is FIPS 140-2 Level 3-certified, which means it has a tamper-evident seal for physical security to detect and respond to attempts to access, use or modify the cryptographic module. While it can't blow up and self destruct, it will lock down and reformat after 10 intrusion attempts.

[www.kingston.com](http://www.kingston.com)



#### 5. **APPLE MACBOOK (SPACE GRAY)**

Need to sneak into an office to steal files? For a job like this, it almost seems as if Apple's new MacBook was designed specifically for the job. First of all, the MacBook is insanely thin and light. It weighs just 920g and measures just 13.1mm at its thickest point. Few notebooks are as portable and this is important because you never know when you'll need to make a run for it. Every extra gram slows you down and the MacBook ensures that you'll never be encumbered. Plus, it's a speedy little machine too, thanks to an Intel Core M processor and the super responsive PCIe-based SSD that supports the NVMe protocol.

[www.apple.com](http://www.apple.com)



## CORPORATE ESPIONAGE MUST HAYES

## SELECT YOUR GEAR

With an ultra-secure fingerprint scanner and an upgraded camera that's perfect for 4K video (it will catch things even your trained spy eyes can't see), the iPhone 6s is an essential companion. And forget Moneypenney, Siri is the ultimate sidekick. Blend seamlessly into any party conversation as she provides you with an endless supply of information on any topic from Ugandan politics to the latest stance on gluten-free food. You can even ask her for joke material.

Need to fit in with the dinner crowd? The Thanko Spy Watch is a stylish dress watch that comes with 4GB of internal storage and a pinhole camera that records video in 720p, and photos in 1600x1200 resolution. What's more, the watch has full video out capabilities, so you can hook it up to a television screen or computer to do real-time video surveillance work, or to do a briefing based on the footage captured.

A close-up photograph of a black and silver chronograph watch with a black leather strap, worn on a person's wrist. The watch features a black dial with three sub-dials and a date window. The strap is black with silver stitching. The image is set against a white circular background.

Suspect someone's snooping around your hotel room? Then you'll definitely need this next gadget. As the name implies, the Peephole Reverser lets you look inside a room with a peephole thanks to its specially designed lens. The viewing range is only plus/minus 15 degrees through doors, with a maximum depth view of 10 feet, but that should be plenty for a well-trained spy like you to discern if danger awaits behind closed doors.





**4.  
SONY  
ICD-UX543F**

With a thin and compact body that fits any shirt pocket nicely, the Sony ICD-UX543F is a digital voice recorder with a built-in USB port that you can plug directly into your computer to transfer your recorded files. It comes with 4GB of internal storage; and if that isn't sufficient, you can pop in a microSD card. Since missions can sometimes be boring and involve lots of waiting, you can use it to listen to FM radio, or load it up with tracks since it's also a capable MP3 player. A fast 3-minute will give you 60 minutes of non-stop recording.

[www.sony.com](http://www.sony.com)



**5.  
MITAMANMA  
STYLISH SPY GLASSES**

So you're at a party and you're just minding your own business as you go around mingling with the crowd... or are you? With these glasses, a simple tap on the ear hook triggers a tiny 2mm-sized camera hidden in the frame. It takes photos at up to 4032x3024 resolution and videos in 1920x1080 resolution in MJPG format and stores it all on microSD, for easy retrieval later. Small, discreet, and takes only 2 hours to recharge.

[www.thanko.jp](http://www.thanko.jp)





# THE CHRISTMAS TRAVELER

by Koh Wanzai

'Tis the season to be jolly again, and maybe we can help with that with a selection of gadgets to consider before you jet off to somewhere where it actually snows. Whether you're an audiophile, an amateur photographer, or simply a regular Joe, one of these compact, travel-friendly gadgets might just help you get more out of your trip.



## POLAROID SNAP

[WWW.POLAROID.COM](http://WWW.POLAROID.COM)

The Polaroid Snap is both digital camera and classic Polaroid. It recreates the traditional, spontaneous Polaroid experience with instantaneous photos, but also lets you easily share and upload your best pictures to social media with the push of a button. In addition, you can select from color, black and white, or vintage capture modes – a modern take on a nostalgic technology. It relies on a novel ink-free Zero Ink Printing technology that uses heat to activate and colorize dye crystals on the specialized ZINK printing paper. The best part is that this is all packed into a slim and compact design that fits into a shirt pocket.



## GOOGLE CHROMECAST (2015)

[WWW.GOOGLE.COM/CHROMECAST](http://WWW.GOOGLE.COM/CHROMECAST)

The new Google Chromecast is quite a radical departure from its predecessor, at least in the looks department. Gone is the thumbdrive shape of the original Chromecast – the 2015 model has a spunky, round design with a long, flexible HDMI connector that will fit much better with TVs with crowded ports. It also supports the faster 5GHz Wi-Fi spectrum now, and comes with three internal antennas – over the previous two – for improved streaming performance. This also equips it to take full advantage of modern AC1900 routers. You can get it in black, red, or yellow.



## PEBBLE TIME ROUND

[WWW.PEBBLE.COM](http://WWW.PEBBLE.COM)

The Pebble Time Round is Pebble's thinnest and lightest smartwatch yet. At 7.5mm thin and weighing just 28g, it makes for a supremely svelte and stylish smartwatch. The signature Pebble always-on e-ink display also makes an appearance here, and you can take your pick of many different watch faces on the Pebble app store. Of course, its slim profile comes with trade-offs, and you'll only get two days of battery life instead of the week-long endurance of the Pebble Time/Time Steel. However, it does charge wonderfully fast, and 15 minutes of charge time will get you a day of use.





**ACER PREDATOR 8**  
[WWW.ACER.COM.SG](http://WWW.ACER.COM.SG)

Gaming PCs you've heard of, but gaming tablets? Either way, the eight-inch Acer Predator 8 tablet might be the best thing for the kids, especially when it comes to keeping them entertained on long holiday car rides or on the plane. Powered by an Intel processor and graphics, it has the necessary computing heft for slick gaming performance on Android. Soft-touch grip pads on the bottom help you get a firm grip on the game at hand, and a haptic feedback mechanism – along with a quad-speaker setup – will let you literally feel and hear the grind of the asphalt beneath your virtual tires.



**SONY NW-ZX100HN WALKMAN**  
[WWW.SONY.COM.SG](http://WWW.SONY.COM.SG)

Make no mistake, this is no iPod. Targeted at serious audiophiles, the NW-ZX100HN Walkman features a new digital noise cancelling function that is compatible with high-resolution audio (HRA) files. Even if you're dealing with compressed MP3 files, Sony's DSEE HX upscaling technology is there to analyze your music and fill in the information gaps, so you get better sounding treble and overall fuller music. Drilling down to the details, careful selection of component materials helps create a more taut bass and distinct vocals. And all this in a slim aluminum frame that packs 45 hours of battery life!





## HWM + HARDWAREZONE.COM TECH AWARDS 2016

The annual HWM+HardwareZone.com Tech Awards is back once again to honour all the revolutionary tech products launched in the past year! Get ready for tech overload as we round up a wide variety of categories, from tech products and software to communication and digital entertainment, to give props to the best in the industry this year.

Find out what our editors and tech gurus favour in the Editor's Choice Awards, and be a part of the judging panel by casting your votes in the Readers' Choice Awards!

# VOTE NOW!

Visit [techawards.hardwarezone.com.sg](http://techawards.hardwarezone.com.sg)

Attractive prizes worth more than \$6,000 to be won!



### 1st Prize worth up to \$3,300

A pair of round trip tickets to anywhere worth up to \$2,400, a Philips Shaver Series 9000 and a Philips Sonicare Airfloss



### 2nd Prize worth over \$1,800

A Philips Air Purifier, a Philips Shaver Series 9000, a Philips Sonicare DiamondClean and Zalora gift card worth \$300



### 3rd Prize worth over \$1,100

A Philips Shaver Series 7000, a Philips Sonicare DiamondClean and Zalora gift card worth \$400

### Consolation prizes:

**10 WINNERS** will receive a Starbucks card worth \$10 each!



Voting period ends on **21 December 2015**.  
Terms and conditions apply.

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TEST

# LAB RESULTS

Every month behind the doors of our super secret gadget testing facility, the latest tech products are put through their paces using industry recognized benchmarks and our own blend of real world usage scenarios. Here are our findings.

## MORE INSIDE >

### APPLE IPAD MINI 4

For the mini, the fourth time's the charm.

### HUAWEI NEXUS 6P

Finally, a metal nexus appears.

### SAMSUNG GEAR S2

The round-faced smartwatch that's actually smart.



#### HOW WE RATE:

Products are rated on a scale of **1** to **10**; **1** being so abysmal, it should be a crime to sell it, and **10** being almost perfect. Come now, nothing is perfect. An Editor's Choice may also be awarded based on unique merits.





# A SHINING EXAMPLE

Shopping for a projector, be it for the office or classroom, is such a chore. And while you can compare specs, it's hard to compare real world performance at the shop front. And that's where we come in. We tell you which of these three new models in the market gets our nod for best business projector.

Text by *Ng Chong Seng*

Photography by *Zaphs Zhang + Angela Guo*

Art Direction by *Ken Koh + Ian Chong*

**VS**  
CANON LV-WX320  
•  
EPSON EB-W31  
•  
NEC M323W



## CANON LV-WX320

The WX320 is one of two compact portable projectors recently added to Canon's LV range, the other being the XGA-based X320. A WXGA (that is, 1,280 x 800 pixels) model, it has a maximum brightness of 3,200 lumens, a contrast ratio of 10,000:1, and tips the scale at 2.5kg.

Like the other Canon LV series projectors, the WX320 is designed for both home and work use. Because it's based on Digital Light Processing (DLP) tech, its lamp system doesn't use any filters, which in turn helps to reduce maintenance and operating costs in the long run. Under normal use, the lamp lasts a good 4,000 hours. If your room is small and you can tolerate a 20% light drop, you can stretch that to 6,000 hours by using the Eco mode.

Equipped with two VGA and one MHL-

compatible HDMI inputs, the LV-WX320 is ready for analog and digital sources, including smartphones and tablets. There's also a RS-232C interface, a RJ45 network jack, and even a good old S-Video terminal. And since it supports DLP-Link, you can easily repurpose it to be a 3D projector (no 3D glasses are provided, by the way). This is something that 3LCD projectors can't do.

With clearly labelled connections, easily adjustable feet, and the presence of horizontal and vertical keystone corrections, the LV-WX320 didn't take us long to set up. Even when projecting on a non-white surface, we were able to quickly color-correct the image with the Screen Color function. If we're allowed to nitpick, it'll be the lens' rather restrictive 1.1x zoom ratio; so make sure you confirm your screen size before wall-mounting it.

**+  
Decent feature  
set and  
performance at  
an affordable  
price.**

**-  
Only 1.1x  
zoom lens.**



### AT A GLANCE

**Brightness**  
3,200 lumens

**Contrast Ratio**  
10,000:1

**Zoom Ratio**  
1.1x

**Lamp Life**  
4,000 hours

**Price**  
\$1,099



The HDMI input is MHL compatible, allowing you to connect to mobile devices.



The 1.1x zoom ratio can be a tad limiting.



Be careful not to misplace the small and flat remote.

## EPSON EB-W31

Sitting just below the WUXGA-capable EB-U04 this year is the brighter 3,200-lumen EB-W31. Unlike Canon's LV-WX320, this EB-W31 uses 3LCD tech. In the past, we'd hand the color advantage to 3LCD projectors, and the size advantage to DLP projectors - but such differences are mostly negligible today. In fact, at 2.4kg, the EB-W31 is the lighter of the two.

The EB-W31 is well endowed in terms of connectivity, sporting a wide range of video inputs, including VGA, S-Video, composite, and HDMI. In addition, it has a USB Type A port for connecting to peripherals, such as USB memory and Epson's own document camera. There's also a USB Type B port for display and input control over just a USB cable.

The EB-W31 is able to sense incoming

signals and turn itself on automatically and change to the correct input. Startup only takes a few seconds, though full brightness is reached in only about 45 seconds. The front exhaust is a nice touch to keep hot air away

from the audience, and we like that the lamp lasts up to 10,000 hours under Eco mode (light output drops about 30% in this power-saving mode). There's an air filter you need to change; in most cases, you only need to change it when you change the lamp.

To nitpick, the projector has no built-in networking support, though the saving grace is you can add wireless connectivity via a separately sold adapter.

Paired with the Epson

iProjection app, which you can download from the Apple App Store or Google Play store, you can then walk around with your mobile device to conduct a presentation.



**High white and color brightness.**



**No built-in networking. Weak 2W speaker.**



### AT A GLANCE

#### Brightness

3,200 lumens

#### Contrast Ratio

15,000:1

#### Zoom Ratio

1.2x

#### Lamp Life

5,000 hours

#### Price

\$1,099



Two sliders above the lens for quick horizontal keystone adjustment and image muting.



Good inputs, but no built-in control and network interfaces.



The candy bar-shape remote is easy to handle.

## NEC M323W

Of the three new WXGA projectors in NEC's recently refreshed M series, the M323W is the most affordable. Still, it comes in at \$200 more than the both the Canon LV-WX320 and Epson EB-W31, which is substantial if you're on a shoestring budget.

So what extras does the M323W offer to command such a premium? On paper, this DLP projector's 3,200-lumen brightness and 10,000:1 contrast ratio specs are on a par with the Canon and Epson models. Its up to 8,000-hour lamp lifespan (under Eco mode) is longer than what the Canon beamer is capable of, but shorter than the Epson projector's 10,000-hour claim. But the M323W does pack a few items that its peers lack, most notably a long 1.7x lens zoom ratio and a powerful 20W speaker. If you need the added placement flexibility or

is looking for a projector better suited for a larger room, the M323W may just be it.

The M323W has a USB port that accepts USB flash drives, so you can present without a PC. It's also the only one in this roundup to come with two HDMI ports and a monitor-out terminal. Sadly, NEC isn't able to fit in a wireless LAN module, though that's still achievable if you buy the optional dongle. For admins, unified control and projector management can be done through the free software provided.

With fast sensing of computer signals, one-touch optimization, automatic keystone correction, an integrated lens cover that lets you mute audio and video quickly, the M323W is easy to setup and use. Our main gripe is that at 3.5kg, the projector isn't as portable as the others.

**+**  
**Tons of connections and software features.**

**-**  
**Only 3,500 hours lamp life at full power. Heavy.**



### AT A GLANCE

**Brightness**  
3,200 lumens

**Contrast Ratio**  
10,000:1

**Zoom Ratio**  
1.7x

**Lamp Life**  
3,500 hours

**Price**  
\$1,299



The 1.7x lens zoom ratio provides a lot of placement flexibility.



Plenty of analog and digital I/Os can be found at the back.



Many functions have their own dedicated button on the long remote.



## IMAGE QUALITY & PERFORMANCE - CANON LV-WX320

In our tests, the LV-WX320 produced a bright image with natural colors, testament of the progress DLP tech has made in recent years. We also noted good vibrancy and contrast, thanks to the 6-segment color wheel. Truth be told however, despite its 3,200-lumen rating, we didn't find the LV-WX320 as bright as the 3LCD-based Epson EB-W31. Color separation artifacts (a.k.a. 'rainbows effect') were few and far between.

We had no difficulties with text sharpness too, even at non-native resolutions. A big 100-inch image can be had even if you were to place the projector as far as 3.7m from the screen. Remember though, light output drops the further the projection distance; so too when Eco mode is engaged (in this case, down to 2,550 lumens). Cabinet noise also dropped to a low 31dB under this energy-saving mode.

While it's not designed to be a home theater projector, we had no problems sitting through the whole of *The Dark Knight* with the LV-WX320. Details struggled in low APL scenes, but that's to be expected, and the pleasing colors more than made up for it. The 10W monaural speaker did go pretty loud, and suffered little distortion.



夏休みに自宅でのんびりして  
に一人で山へ行きたくなった。  
去年同好会有志で登った北アル  
とにした。夏休みのため、電車  
合っていた。いつものとおり早  
に備える。

Despite being a DLP projector, the Canon LV-WX300 exhibited bright and pleasing colors. Text looked sharp too. The 1.1x lens zoom ratio was a bit limiting during setup though.

## IMAGE QUALITY & PERFORMANCE - EPSON EB-W31

The EB-W31 has a 3,200-lumen color light output spec, which means it's able to deliver the same level of brightness for color images. Certainly, if brightness is your top priority, be it white or color brightness, 3LCD projectors like this EB-W31 usually hold an advantage over their single-chip DLP rivals.

One thing we were worried before this was the EB-W31's color accuracy. Thankfully, while brightness did dip for the EB-W31 when we tried to remove the slight blue tint, the drop wasn't much, so both brightness and contrast remained high after the adjustments. Better yet, we were able to regain some highlight detail.

Unless you sit very close to the screen, you also shouldn't notice the pixel structure of this WXGA projector. On a white background, black text looked great even at small font sizes, but a hint of color fringing around smaller lettering remained visible when viewed up close. As always, Cinema mode is recommended for movie content; and if you're in a small room and don't need all the brightness, Eco mode has the added benefit of lowering the operating noise to a mere 28dB. The puny 2W mono speaker is nothing to shout about though.



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に一人で山へ行きたくなった。  
去年同好会有志で登った北アル  
とにした。夏休みのため、電車  
合っていた。いつものとおり早  
に備える。

While brightness dipped a bit when we tweaked the colors, the Epson EB-W31 remained the brightest projector of the trio. Central sharpness was good too.



## IMAGE QUALITY & PERFORMANCE - NEC M323W

In terms of white brightness, the 3,200-lumen M323W is on a par with the Canon LV-WX320 and Epson EB-W31. However, Epson's offering does steal a lead when it comes to color brightness, offering slightly brighter reds, greens, and yellows.

That being said, high brightness is useless if the image suffers from color problems. The M323W fared well in our color accuracy tests, even when it was fresh out of the box without any tweaking. For those who wish to dial it in further, there are gamma and color temperature controls. Also, one of the presets is a DICOM simulation mode meant for healthcare practitioners who need to reproduce medical images.

Overall, we noted sharp text, good contrast, and saturated colors from the M323W. The flexible 1.7x zoom lens and loud 20W speaker are standouts that we don't see on its peers; the latter a more obvious advantage when we tried to fill up the room with sound when watching *The Dark Knight* movie. Speaking of which, Movie mode is best used for such content, especially if you've a dimmed room. Our only gripe with the M323W is that NEC only rated the lamp life to be 3,500 hours under normal use.



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に一人で山へ行きたくなった。  
去年同好会有志で登った北アル  
とにした。夏休みのため、電車  
合っていた。いつものとおり早  
に備える。

We noted sharp text and reasonably high brightness levels across the zoom range. While color brightness wasn't the highest, hues looked natural, with good contrast.





MODEL	CANON LV-WX320	EPSON EB-W31	NEC M323W
TECHNOLOGY	DLP	3LCD	DLP
NATIVE RESOLUTION	1,280 x 800 (WXGA)	1,280 x 800 (WXGA)	1,280 x 800 (WXGA)
LENS ZOOM	1.1x	1.2x	1.7x
BRIGHTNESS (MAX/ECO)	3,200/2,550lm	3,200/2,240lm	3,200/1,920lm
CONTRAST RATIO	10,000:1	15,000:1	10,000:1
KEystone CORRECTION	±30° (V/H)	±30° (V/H)	±30° (V), ±25° (H)
INPUT - VIDEO	2 x VGA, HDMI, S-Video, composite	VGA, HDMI, S-Video, composite	VGA, 2 x HDMI, composite
MONITOR OUT	No	No	Yes
CONTROL & NETWORK	RS-232C, RJ45	Wi-Fi (optional)	RS-232C, RJ45, Wi-Fi (optional)
USB VIEWER	No	Yes	Yes
SPEAKER	10W	2W	20W
NOISE LEVEL (MAX/ECO)	38/31dB	37/28dB	33/27dB
POWER CONSUMPTION (MAX/ECO)	350/240W	277/207W	283/186W
LAMP LIFE (STD/ECO)	4,000/6,000 hours	5,000/10,000 hours	3,500/8,000 hours
DIMENSIONS	282 x 232 x 114.5mm	297 x 234 x 77mm	368 x 292 x 108mm
WEIGHT	2.5kg	2.4kg	3.5kg
PRICE	\$1,099	\$1,099	\$1,299

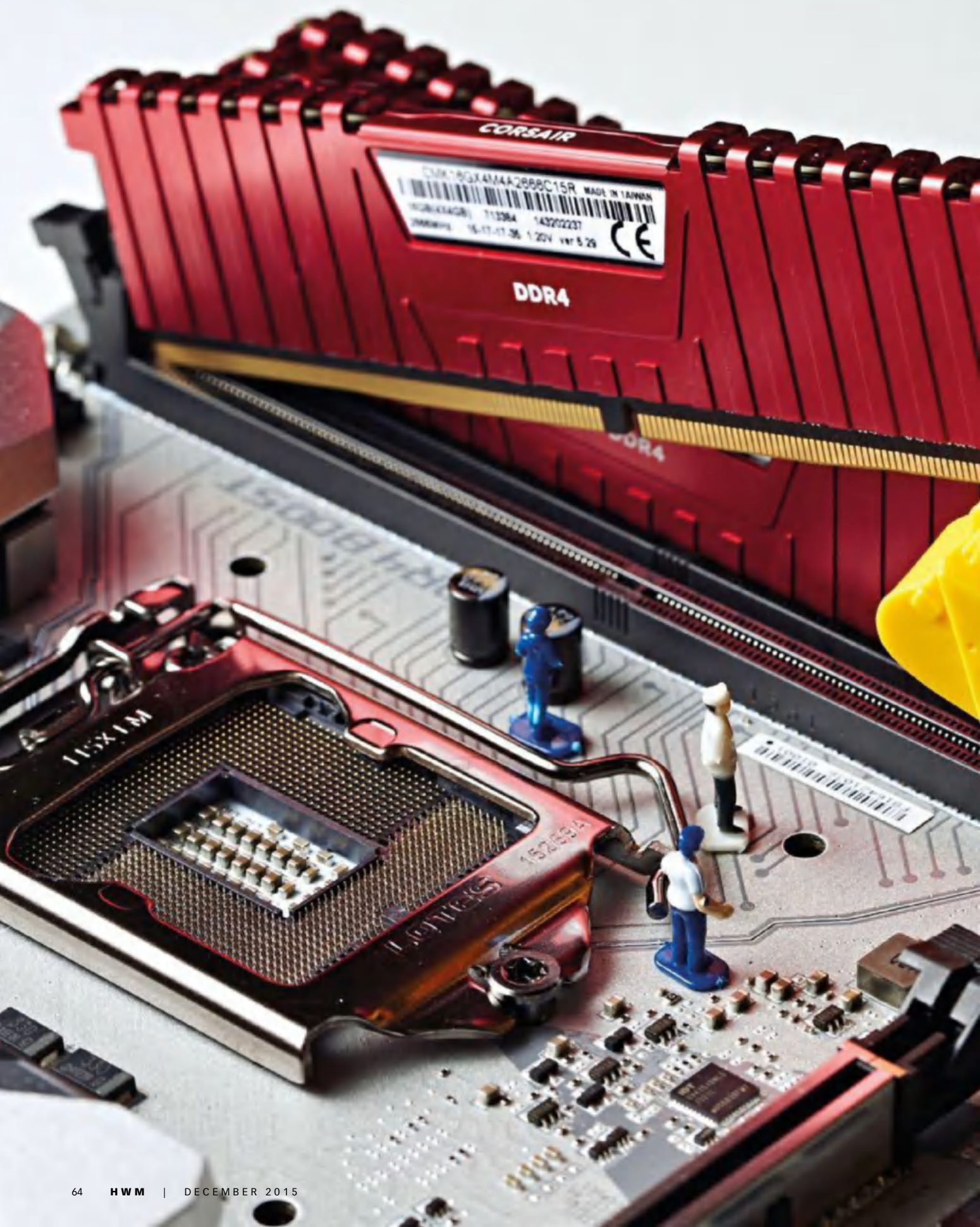
# AND THE BEST WXGA BUSINESS PROJECTOR IS



## NEC M323W

With pleasing colors and sharp text, the NEC M323W is a performer. Although priced \$200 more than the Epson EB-W31, you get more connectivity options, including network and control interfaces. A highly flexible projector with dual HDMI inputs, its 1.7x lens zoom ratio and 20W speaker also mean it's equally comfortable in a larger room. The only downside; its 3,500-hour lamp life under normal use is a tad low, though it can hit 8,000 hours under Eco mode.

The 3LCD Epson EB-W31 though, excelled in the brightness and contrast departments (and that was even after we lowered the brightness to get the colors to be more accurate). Also, at 2.4kg, it's so much easier to carry from place to place than the 3.5kg M323W. However, Epson's decision to pack only the most essential of ports makes it less of an all-rounder than the NEC model in a business environment.





# BATTLE OF THE INTEL Z170

Intel's new Z170 chipset is a major milestone in many ways. At long last, DDR4 support has arrived and PCIe 3.0 lanes are available through the chipset. Many boards now bristle with a wide array of storage, connectivity and value-added features. Let's find out which brings out the best of Z170.

Text by Koh Wanzi

Photography by Zaphs Zhang + Jasper Yu

Art Direction by Ian Chong



VS

ASROCK Z170 EXTREME 7+

ASUS Z170 DELUXE

ECS Z170 CLAYMORE

GIGABYTE Z170X  
GAMING GT

MSI Z170A XPOWER  
GAMING TITANIUM EDITION

## ASROCK Z170 EXTREME 7+

This ASRock motherboard is the top model in ASRock's Z170 Extreme series of motherboards. For starters, the board has a rather stealthy look with its matte black PCB and heatsinks, with only subtle accents of copper that inject a bit of design flourish.

It uses a 12-phase digital power design, which isn't as elaborate as some of the other boards in this shootout. However, the number of phases actually matters less than the quality of the components themselves. As we'll see later, the ASRock actually performed better in our overclocking tests than the 14-phase Gigabyte Z170X Gaming GT.

Going by the results, it looks like ASRock is justified in highlighting the premium 60A power chokes and Nichicon capacitors that deliver a cleaner and more stable Vcore to the CPU.

The board has a total of four PCIe 3.0 x16 – the first three will run in x8/x4/x4 modes in triple-GPU setups, while the last slot is limited to just x4 mode. In addition, there is a single PCIe 3.0 x1 and PCIe 2.0 x1 slot for add-in cards.

Speaking of add-in cards, ASRock has also thoughtfully included a half-size mini PCIe connector above the topmost PCIe 3.0 x16 slot. This is good for things like Wi-Fi add-in

cards, so the board's lack of onboard Wi-Fi need not be a dealbreaker.

When it comes to storage options, the ASRock Z170 Extreme 7+ serves up quite a selection too. There are a total of ten SATA 6Gbps ports (six from the chipset and four from an ASMedia ASM1061 controller), three SATA Express connectors, and an impressive three M.2 sockets that support both PCIe and SATA devices. Taken together, that's a lot more

options than the other boards offer.

Notable features on the rear I/O panel include one USB 3.1 Type-A and one Type-C port from the ASMedia ASM1142 controller. There's also a wider selection of display connectors than usual with a single DVI-D port, one HDMI port, and one DisplayPort connector.

The dual Intel LAN ports support teaming, which means you can connect two LAN cables simultaneously and combine them for a

single faster connection. In addition, there's a dual BIOS feature for peace of mind while overclocking or updating your BIOS.

Finally, because of the "plus" moniker in its name, the board comes bundled with a USB 3.1 Type-A and Type-C front panel, which plugs into the SATA Express port on any motherboard for a couple of extra USB ports.

**+**  
**Wide range of connectivity options.**

**–**  
**Stock performance loses out slightly to rival boards.**



### AT A GLANCE

#### Memory

4x DDR4 DIMMs up to DDR4 3866

#### Expansion

4x PCIe 3.0 x16; 1x PCIe 3.0 x1; 1x PCIe 2.0 x1; 1x half-size mini-PCIe

#### USB 3.0

4x rear; 4x front

#### SATA

10x SATA 6Gbps

#### Price

\$475



The board is bundled with a USB 3.1 Type-A and Type-C front panel.



The BIOS switch lets you recover from a failed BIOS flash.



The Purity Sound 3 onboard audio solution can power headphones up to 600ohm.



## ASUS Z170 DELUXE

The ASUS Z170 Deluxe sits at the top of the company's Signature series of boards. Although it is not a member of the performance-oriented Republic of Gamers (ROG) line-up, it is still a top-flight board with premium features and a decidedly attractive design aesthetic.

We really like its look; the white I/O cover and heatsinks go extremely well with the matte black PCB and the accents of gunmetal gray on the VRM and PCH heatsinks.

Despite not being targeted expressly at gamers, the Z170 Deluxe still sports an impressive 16-phase digital power

design. This time, it looks like the beefed-up number of power phases paid off as the ASUS board turned out to be the best overclocker.

Its three PCIe 3.0 x16 slots run at x8/x4/x4 in triple-GPU setups. A further four PCIe 3.0 x1 slots are available should you wish to install additional add-on cards.

We like how ASUS has left a space of three slots between the first and second PCIe 3.0 x16 slots. The vast majority of graphics cards today take up only two slots – even a powerful one like the NVIDIA GeForce GTX Titan X – and this ensures that dual-GPU systems will have enough space between cards for them to breathe.

Moving on to storage options, there are

six SATA 6Gbps ports from the Intel Z170 chipset itself, and an additional two such ports provided by a third-party ASMedia ASM1061 controller.

Unlike the ASRock board, the ASUS Z170 Deluxe has just one M.2 socket at the lower right corner. It will support SATA and PCIe devices ranging from 30mm (2230) to 110mm (22110) in length, which just about covers any M.2 drive out there.

If you want to run a couple of M.2 drives in RAID 0, you still can. The included Hyper M.2 PCIe add-in card plugs into the third PCIe 3.0 x16 slot and will accommodate a second M.2 drive. There is also a bundled U.2-to-M.2 adapter for hooking up PCIe-based 2.5-inch drives.

In terms of standout features, the Deluxe is the only board to have wireless support with an included 3x3 802.11ac Wi-Fi module and Bluetooth 4.0 support. The 3x3 array is a welcome feature as it lets users

take full advantage of high-end AC1900-class routers.

ASUS also evinces a preference for USB 3.1 as the rear I/O panel boasts the greatest number of USB 3.1 ports among the boards in our shootout. There are six USB 3.1 ports – including one Type-C port – and just one USB 3.0 and one USB 2.0 port.

  
**3x3 802.11ac Wi-Fi  
and Bluetooth 4.0  
support.**

  
**No dual BIOS.**

### AT A GLANCE

#### Memory

4x DDR4 DIMMs up to  
DDR4 4000

#### Expansion

3x PCIe 3.0 x16;  
4x PCIe 3.0 x1

#### USB 3.0

1x rear; 4x front

#### SATA

8x SATA 6Gbps

#### Price

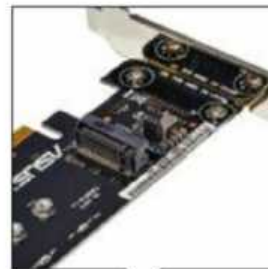
\$559



The 3x3 Wi-Fi module interfaces with the rear I/O panel to provide wireless support.



The onboard Crystal Sound 3 audio features a de-pop circuit to reduce annoying popping noises.



The board comes bundled with a Hyper M.2 PCIe add-in card.





## ECS Z170 CLAYMORE

There wasn't much choice from ECS this time around and the Z170 Claymore was the only board available for review. There is a considerable price gap between this board and the others, so one simply cannot expect it to be as feature-rich as its competitors. Nevertheless, we'll be looking at it anyway to better flesh out our comparisons.

The Claymore is a lot less explosive than its name. It sports a nearly all-black design, with a black PCB, heatsink, and PCIe and RAM slots. The PCH heatsink has the ECS L337 logo emblazoned on it, but that's about the most striking stylistic detail on this board.

It is also the only one – other than the MSI board – to not have an I/O cover, which is not really surprising given its price.

When it comes to PCIe 3.0 x16 slots, it looks like the design philosophy so far has been “the more the merrier”. There are no PCIe 3.0 x4 or x1 slots at all, and ECS has instead implemented a total of five PCIe 3.0 x16 slots. Of course, there is still a limited number of PCIe 3.0 lanes to go around, so the slots run in either x16/x4/x0/x1/x4 or x8/x4/x8/x1/x4 modes. In addition, there is only official support for AMD CrossFire, making it the only board to lack support for

NVIDIA SLI.

But even though the majority of users are not likely to be running more than two GPUs on Intel Z170, this slot configuration is a good example of the flexibility which Z170's HSIO port layout offers motherboard manufacturers. ECS is using the majority of Z170's chipset lanes for its PCIe 3.0 slots, but at the expense of the bandwidth available to the single onboard M.2 socket. Instead of the

more common support for PCIe 3.0 x4, the socket only supports PCIe 3.0 x2 or SATA.

Storage options are relatively sparse, with just four SATA 6Gbps connectors and a single SATA Express port available through the chipset. ECS did manage to add two more SATA ports via an ASMedia 2-port controller, but it is still limited by the PCIe 2.0 interface, so you're not going to want to use these ports if possible.

On the rear I/O panel, there are two separate PS/2 controllers for keyboard and mouse. This looks like it might just be a waste of space, as most users will already struggle to find use for a single PS/2 port. Furthermore, Type-C USB ports are missing. However, given the low price of the ECS board, we probably shouldn't be surprised.

**+**  
**Very affordable price.**

**–**  
**Performance lags competing boards by a wide margin.**



### AT A GLANCE

#### Memory

4x DDR4 DIMMs up to DDR4 3200

#### Expansion

5x PCIe 3.0 x16

#### USB 3.0

4x rear; 2x front

#### SATA

6x SATA 6Gbps

#### Price

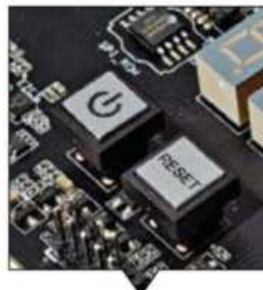
US\$160



The onboard audio is missing any dedicated amplifiers or high-end op-amps.



The board features a 12-phase power design.



The power and reset buttons and debug LED are located at the bottom right corner.

## GIGABYTE Z170X GAMING GT

The Gigabyte Z170X Gaming GT is located just below the flagship Z170X Gaming G1. In other words, it's still a high-end board, but with less extravagant features and a slightly more palatable price.

Frankly speaking, we found the choice of color combination a tad bit jarring. The matte black PCB is too muted a background for the striking red-and-white I/O cover and heatsinks.

The board features a modest 14-phase

power design. But even though this is more than the 12 power phases on the ASRock Z170 Extreme 7+, the Gigabyte actually did worse in our overclocking tests.

One standout feature is the use of stainless steel shielding to reinforce the slots. We're sure we're not alone in worrying about a board's PCIe slot when installing a particularly heavy card, so it's definitely reassuring to have some form of structural reinforcement.

All three of the board's PCIe 3.0 x16 slots (x8/x8/x4) utilize this stainless steel shielding, and Gigabyte has also taken care to leave an extra-wide gap between the first and second slots in order to leave sufficient room for ventilation in dual-GPU systems.

In addition, there are a further two M.2 sockets for both PCIe and SATA devices.

However, the second M.2 slot actually shares bandwidth with the third PCIe 3.0 x16 slot, so if you do install an M.2 drive in the second slot, that PCIe 3.0 slot will no longer be useable.

Gigabyte has also gone with a total of eight SATA 6Gbps ports, six from the Z170 chipset and two from an ASMedia ASM1061 controller. Three SATA Express connectors are thrown into the mix as well.

On the rear I/O panel, there is one USB 3.1 Type-C port, in addition to a host of regular Type-A USB 3.1 and 3.0 ports. One thing to note is that Gigabyte has opted for an Intel Alpine Ridge controller instead of the more common ASMedia ASM1142 for USB 3.1 support. Unlike the latter controller which supports just two PCIe lanes, Alpine Ridge is a four-lane PCIe controller that supports the maximum data rate of USB 3.1.

Finally, the onboard audio solution features a quad-core Creative Sound Core 3D audio processor, two TI Burr Brown OPA2134 op-amps, and Nichicon Muse MW capacitors. That's quite impressive, and the op-amps can even be swapped out for higher end parts, or if you want to alter the sound signature. Now that's something you don't see every day in an onboard audio solution.



**Comprehensive onboard audio solution.**



**Overclocks poorly compared to competing boards.**



### AT A GLANCE

#### Memory

4x DDR4 DIMMs up to DDR4 3866

#### Expansion

3x PCIe 3.0 x16;  
3x PCIe 3.0 x1

#### USB 3.0

5x rear; 4x front

#### SATA

8x SATA 6Gbps

#### Price

\$565



Dedicated Creative Sound Core 3D audio processor and upgradeable op-amps.



Dual BIOS helps the board recover from failed BIOS flashes.



Two dedicated USB 3.0 ports for a cleaner signal to USB DACs.

## MSI Z170A XPOWER GAMING TITANIUM EDITION

The MSI Z170A XPower Gaming Titanium Edition appears designed to turn heads. From its intriguing name – is it made of titanium? – to its slate gray color, this board doesn't look like most of what's available today.

Its striking look is thanks to a PCB coating that confers its light gray color, which is intended to evoke the Titanium moniker in its name. MSI may have just hit on something here, as the board's design manages to hold your gaze without any overtly fancy trappings.

Unfortunately, it's lacking an I/O cover, making it the only other board in our line-up – along with the ECS Z170 Claymore – to not have one.

But as further testament to its Titanium branding, the board uses titanium chokes and a 16-phase power delivery system. There's more than just marketing fluff to this; titanium chokes have higher temperature limits, higher inductance density, and longer lifespan than traditional ferrite core chokes.

This board is unabashedly targeted at overclockers, and it includes additional 4- and 6-pin CPU and PCIe headers to provide more power stability for extreme overclockers. And by extreme, we mean those who are willing to push their chips with LN2 cooling.

There are a total of four PCIe 3.0 x16 slots, and the first and third slots are reinforced with

steel as in the Gigabyte board. If you have dual graphics cards, these slots are where you should install them. This also happens to leave a four-slot spacing between the two cards, which should be plenty of room for them to breathe.

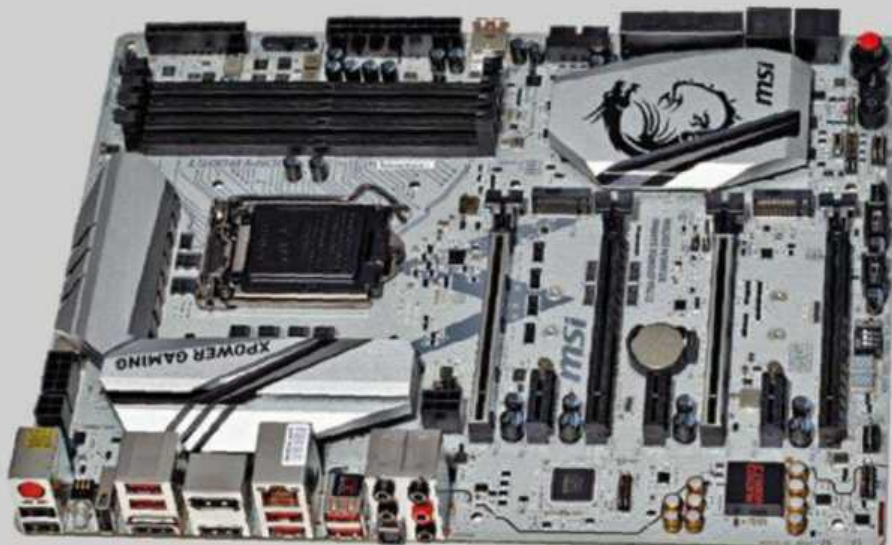
Storage connectivity options include six SATA 6Gbps ports from the chipset itself, an additional two via an ASMedia ASM1061 controller, and two more combination SATA Express ports. There are also two M.2 sockets for both PCIe and SATA devices. Of course, you can't populate them all at once, and installing two M.2 devices will leave just four SATA 6Gbps ports available.

Other notable features include something MSI calls DDR4 Boost, which supposedly isolates the memory signal for less interference and a higher overclock. Furthermore, a nifty 8-step Game Boost knob at the bottom right corner of the board enables faster overclocking by just turning the knob. Strangely, Game Boost doesn't work on-the-fly, and you'll have to reboot your PC before the changes will apply.

Finally, the board comes bundled with an external OC Dashboard with dedicated buttons for easier overclocking without entering the BIOS. From the looks of it, it's especially suited for a test bench setup as we can't really see users reaching into their case to push buttons.

**+**  
**Excellent stock performance.**

**–**  
**No Type-C USB ports.**



### AT A GLANCE

#### Memory

4x DDR4 DIMMs up to DDR4 4000

#### Expansion

4x PCIe 3.0 x16; 3x PCIe 3.0 x1

#### USB 3.0

4x rear; 2x front; 1x onboard

#### SATA

8x SATA 6Gbps

#### Price

\$559



The CPU comes with an additional four-pin connector for more extreme overclocks.



The Game Boost knob is a quick way to overclock your CPU.



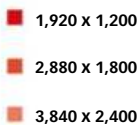
The included OC Dashboard offers overclockers more tactile control over their settings.



## Middle-earth: Shadow of Mordor

(average fps, higher is better)

We tested the boards on Middle-earth: Shadow of Mordor to see how they stack up against each other in terms of real-world gaming performance. As expected, the performance difference between the boards was minuscule, given that the underlying CPU and GPU hardware was the same. Nevertheless, the MSI board just managed to edge ahead at all our tested resolutions. The ASUS Z170 Deluxe was a strong second, while the ASRock board came in third.



ASROCK Z170 EXTREME 7+



ASUS Z170 DELUXE



ECS Z170 CLAYMORE



GIGABYTE Z170X GAMING GT



MSI Z170A XPOWER GAMING TITANIUM EDITION



## SYSmark 2014

(higher is better)

SYSmark is a general productivity benchmark suite that measures the response times of tasks on a PC using real-world applications like Microsoft Office 2013 and Adobe Photoshop and simulated user input. Task response times are used to generate a performance rating that reflects actual experience, so the faster a PC responds to application workloads, the higher its score.

The MSI board came ahead here as well, with the ASUS and Gigabyte boards coming in close behind. The MSI board did especially well in the Office Productivity test, which was what helped it take first place in the overall score.

ASROCK Z170 EXTREME 7+



ASUS Z170 DELUXE



ECS Z170 CLAYMORE



GIGABYTE Z170X GAMING GT



MSI Z170A XPOWER GAMING TITANIUM EDITION



## Overclocking

(higher is better)

We first tweaked the CPU multiplier ratio and raised the voltage accordingly. After ascertaining that the achieved clock speed was stable, we then proceeded to increase the BCLK value to get smaller overclock increments. This also enabled us to take advantage of the new overclocking capabilities of Skylake CPUs, which allow a wider range of BCLK values. Changing the BCLK values also overclocks the RAM, so we throttled the speed accordingly to maintain system stability.

The ASUS Z170 Deluxe was the best overclocker here, and we were able to hit a top speed of 4.86GHz, which translated into a nearly 20% performance increase. The MSI and ASRock boards tied for second place, while the Gigabyte board came in third. The ECS board did not fare well here at all, and pushing the CPU vCore above 1.23V only saw the board restrict our CPU multiplier speeds, and increasing it had no effect. We're not sure if this is due to immature firmware or the board's design, but the ECS Z170 Claymore absolutely failed to hold its own against the other boards.

ASROCK Z170 EXTREME 7+



ASUS Z170 DELUXE



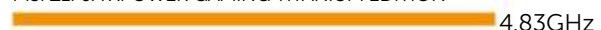
ECS Z170 CLAYMORE



GIGABYTE Z170X GAMING GT



MSI Z170A XPOWER GAMING TITANIUM EDITION



# T E S T - INTEL Z170 MOTHERBOARD SHOOTOUT



MODEL	ASROCK Z170 EXTREME 7+	ASUS Z170 DELUXE	ECS Z170 CLAYMORE	GIGABYTE Z170X GAMING GT	MSI Z170A XPOWER GAMING TITANIUM EDITION
MEMORY	4x DDR4 DIMMs (supports DDR4 3866+, max: 64GB)	4x DDR4 DIMMs (supports DDR4 4000+, max: 64GB)	4x DDR4 DIMMs (supports DDR4 3200+, max: 64GB)	4x DDR4 DIMMs (supports DDR4 3866+, max: 64GB)	4x DDR4 DIMMs (supports DDR4 4000+, max: 64GB)
STORAGE	Intel Z170 chipset: 6x SATA 6Gbps; 3x SATA Express; 3x M.2 socket ASMedia ASM1061: 4x SATA 6Gbps	Intel Z170 chipset: 6x SATA 6Gbps; 1x SATA Express; 1x M.2 socket ASMedia ASM1061: 2x SATA 6Gbps	Intel Z170 chipset: 4x SATA 6Gbps; 1x M.2 socket ASMedia ASM1061: 2x SATA 6Gbps; 1x SATA Express	Intel Z170 chipset: 6x SATA 6Gbps; 3x SATA Express; 2x M.2 socket ASMedia ASM1061: 2x SATA 6Gbps	Intel Z170 chipset: 6x SATA 6Gbps; 2x SATA Express; 2x M.2 socket ASMedia ASM1061: 2x SATA 6Gbps
AUDIO	Realtek ALC1150, with support for Purity Sound 3	Realtek ALC1150, with support for Crystal Sound 3	Realtek ALC1150	Quad-core Creative Sound Core3D processor with 2x TI Burr Brown OPA2134 op- amps	Realtek ALC1150, with support for Nahimic Sound Technology
NETWORKING	1x Intel I219-V; 1x Intel I211AT	1x Intel I219-V; 1x Intel I211AT; 3x3 dual-band Wi-Fi 802.11ac module	Realtek DRAGON LAN 8118AS	1x Intel I219-V; 1x Killer E2400	1x Intel I219-V
REAR I/O	1x PS/2; 1x HDMI; 1x DVI-D; 1x DisplayPort; 2x USB 2.0; 2x USB 3.1 (1 Type-A, 1 Type-C); 4x USB 3.0; 2x RJ-45; 1x Optical S/PDIF Out; 6x audio	1x HDMI; 1x DisplayPort; 1x USB 2.0 (1 USB BIOS Flashback port); 6x USB 3.1 (5 Type-A, 1 Type-C); 1x USB 3.0; 2x RJ-45; 1x ASUS Wi-Fi GO! Module; 1x Optical S/PDIF Out; 6x audio	2x PS/2; 1x HDMI; 1x DisplayPort; 4x USB 2.0; 2x USB 3.1; 4x USB 3.0; 1x RJ-45; 6x audio	1x PS/2; 1x HDMI; 1x DisplayPort; 2x USB 3.1 (1 Type-A, 1 Type-C); 5x USB 3.0; 2x RJ-45; 1x Optical S/PDIF Out; 5x audio	1x PS/2; 2x HDMI; 1x DisplayPort; 3x USB 2.0 (1 BIOS Flashback+ port); 2x USB 3.1 (1Type-A, 1 Type-C); 4x USB 3.0; 1x Clear CMOS button; 1x RJ-45; 1x Optical S/PDIF Out; 5x OFC audio
EXPANSION SLOTS	4x PCIe 3.0 x16; 1x PCIe 3.0 x1; 1x PCIe 2.0 x1; 1x half-size mini- PCIe	3x PCIe 3.0 x16; 4x PCIe 3.0 x1	5x PCIe 3.0 x16	3x PCIe 3.0 x16; 3x PCIe 3.0 x1	4x PCIe 3.0 x16; 3x PCIe 3.0 x1
PRICE	\$475	\$559	US\$160	\$565	\$559

# AND THE BEST Z170 MOTHERBOARD IS



## MSI Z170A XPOWER GAMING TITANIUM EDITION

The MSI Z170A Gaming Titanium Edition was a consistent performer throughout our performance tests. It took first place in SYSmark 2014, 3DMark 2013 and Middle-earth: Shadow of Mordor. It also acquitted itself well in our overclocking tests, going toe-to-toe with the ASRock Z170 Extreme 7+ and falling just shy of the ASUS Z170 Deluxe. Furthermore, it comes with several value-added features like additional CPU and PCIe power headers for improved overclocking capabilities, metal-reinforced PCIe slots, two dedicated M.2 sockets, and onboard Nahimic audio technology. It is also the only board in the line-up to feature an isolated memory circuitry for a cleaner signal and a dedicated OC dashboard. At \$559, it is the same price as the ASUS board but offers slightly more for every dollar (including dual BIOS). And combined with its excellent performance, it manages to edge ahead of the competition.



# BRIDGING THE LINES

With larger sensors and proportionately larger camera bodies built for more heavy duty wear, today's bridge cameras look like their interchangeable lens counterparts, and boast the performance capabilities to match.

Text by *Marcus Wong*  
Photography by *Darren Chang & Jasper Yu*  
Art Direction by *Ken Koh*





vs  
CANON POWERSHOT G3X  
•  
NIKON COOLPIX P900  
•  
PANASONIC LUMIX  
DMC-FZ300

## CANON POWERSHOT G3 X

The Canon Powershot G3 X is the latest in the line of Canon's bridge camera series, offering a larger sensor in a compact body. Like the Panasonic FZ300, it also carries a more "modest" zoom range of 24-600mm (35mm equivalent) compared to the incredible reach of the Coolpix P900, but does so in a much slimmer body.

The one thing it lacks compared to the other two is a built-in viewfinder – Canon offers you an additional purchase of a hotshoe EVF instead. The rear LCD is also slightly less versatile than the other two, with tilt but not swing capabilities. However, it does compensate by adding the element of touch and being able to flip up to what's commonly referred to as "selfie" mode. Unfortunately, the camera doesn't function any differently this way, so you'll have to rely on touch shutter to take the picture.

The body itself is made to be weather resistant, and feels solid in the hands, while not being too bulky. The handgrip is just about deep enough to allow for a proper hold of the camera, and the lens doesn't extend out too far in operation, allowing you to maintain stability even at the zoom's extents.

One thing we wish could have been better implemented though; is the continuous ring that's found around the lens. At the moment it appears the continuous ring can only be used to adjust one function based on the mode you're in. Which means in Program mode you can only use it to adjust your ISO setting or for manual focusing, which seems a real waste when it could easily be

used to adjust other settings or as a zoom ring for the camera. That would definitely speed things up for stills photography, and add more options to the user.



**Larger sensor makes for better high ISO performance.**



**Electronic viewfinder is an additional purchase.**



### AT A GLANCE

#### Sensor

1-inch type

#### Megapixels

20.2-megapixels

#### Focal length

24-600mm, 35mm equivalent

#### Dimensions

123.3 x 76.5 x 105.3 mm

#### Weight (w/batteries)

733g

#### Price

\$1,199.00



You can manually adjust the angle of the pop-up flash.



The hotshoe EVF is an additional purchase.



The delete and zoom buttons aren't obviously marked.



## NIKON P900

While it's listed as a "bridge camera", the CoolPix P900 isn't exactly what you would call compact. What you do get is an incredible telephoto reach of 2000mm (35mm equivalent) in something that will fit easily into a sling bag or backpack, which is quite a feat in itself.

There's a nice, deep handgrip, and the camera feels well-balanced in the hand. The vari-angle LCD is a nice touch, and the electronic viewfinder certainly comes in handy when you're trying to stabilize the camera. The menu system is very much like what you will find on Nikon's 1 series mirrorless cameras – pretty simplified, with no option to shoot to RAW format. What is handy though; is the option to specify a start-up zoom position so if you're on a birding trip for example, you won't lose precious seconds waiting for the lens to go from full wide to telephoto.

**Incredible zoom range is balanced by good handling.**

**Pre-shooting image cache is hampered by poor quality.**

Also present, are a variety of shooting modes that you can choose from to best match your situation. There's the usual Single, Continuous Low and Continuous High, but

now you have the option to use a Pre-shooting cache mode which essentially starts taking images as soon as you half-depress the shutter to focus and stops after you fully depress the shutter. It's a handy function to have when you're trying to capture unpredictable motion, but the image size of each shot is reduced to 1,280 x 960, which is only just about usable for web purposes.

Wi-Fi capabilities have been added so you can shoot direct to a smart device, but what is interesting is that Nikon has added GPS/GLONASS/QZSS support that tracks your location via satellite. This lets you mark specific locations where you are at so that you can revisit them at later dates; probably something useful for the serious traveler.



### AT A GLANCE

#### Sensor

1/2.3-inch type

#### Megapixels

16.1-megapixels

#### Focal length

24-2000mm, 35mm equivalent

#### Dimensions

139.5 x 103.2 x 137.4 mm

#### Weight (w/batteries)

899g

#### Price

\$889



The P900's pop-up flash comes up fairly high.



The movie recording button lies in fairly convenient position.



This button zooms out briefly to let you find your subject.

## PANASONIC LUMIX DMC-FZ300

The Panasonic Lumix DMC-FZ300 is a very interesting proposition, being the smallest and lightest camera of the group. The camera comes with a nice, deep handgrip but the real standout feature is its 25-600mm f/2.8 lens. That's matched with a 12-megapixel BSI CMOS sensor and an updated Venus Engine processor which allows for a native ISO of 6400.

The main control dials are nicely knurled for better feel, and the function buttons are very nicely spread out overall so that everything remains within reach. Zooming is achieved either by the lever in front, or via a slide lever on the lens. While there is also a rotary dial on the lens, that's used for the selection of macro focus modes (AF Macro, Macro Zoom, or Macro off), and for manual focusing, during which the central portion of the frame is enlarged to help you better judge sharpness.

Unlike the other two, the DMC-FZ300 utilizes in-body image stabilization as compared to lens-based image stabilization. And the difference is immediately visible

just in terms of how much smoother the image on the rear LCD is when the camera is zoomed in to the extremes. Where the G3 X and the Coolpix P900 would almost leave you with a headache due to the jerkiness, the Lumix DMC-FZ300 remains stable enough for you to pan and search for your target without having to zoom out.

Worthy of mention, is the touch interface on the Lumix DMC-FZ300. Everything is organized neatly into "drawers" which you can assign almost of the camera's functions to, letting you set the camera up just as you

would like it. That's taking advantage of touch capabilities, and offers a degree of customization that heavy users will definitely appreciate.

**+**  
**Great handling overall with the best use of on-screen menus.**

**—**  
**No functions to help with finding your subject when zoomed in to extremes.**

### AT A GLANCE

#### Sensor

1/2.3-inch type

#### Megapixels

12.1-megapixels

#### Focal length

25-600mm, 35mm equivalent

#### Dimensions

131.6 x 91.5 x 117.1 mm

#### Weight (w/batteries)

691g

#### Price

US\$599



The FZ300's vari-angle LCD is highly convenient.



The extra wheel for manual focus works quite well in practice.



The mode dial has a knurled finish for improved feel.



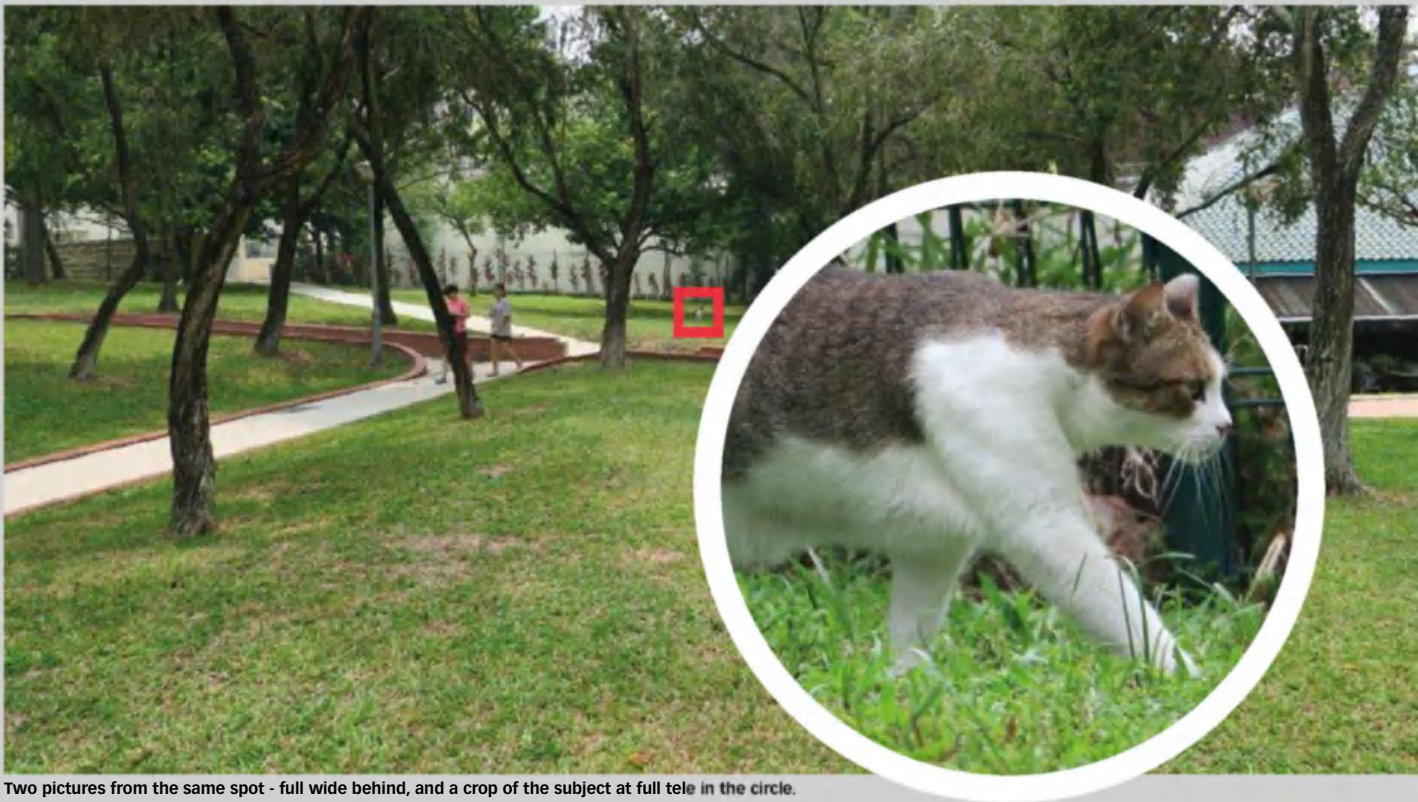


## IMAGE QUALITY & PERFORMANCE - CANON POWERSHOT G3 X

In terms of speed and responsiveness, the Powershot G3 X felt like it was somewhere in between the Nikon and the Panasonic cameras. Still responsive enough in practice; but not quite the fastest. The camera was fairly fast to respond without too much lag between shots, but we did find ourselves a little frustrated by the implementation of the autofocus system. Despite having 31 contrast-detect autofocus points across the frame, the Powershot G3 X only offers two methods of autofocus – face detect with subject tracking and one-point, neither of which offer the flexibility needed of a bridge camera. The major saving grace though, is the much larger 1-inch sensor, as it allows the camera to produce images with less noise and better details than the other two, while turning in the best high ISO performance. We'd use images taken at ISO levels up to 3200 without hesitation, and ISO 6400 should be usable for prints after some sharpening in post.



We'd go up to ISO 6400 with the PowerShot G3 X.



Two pictures from the same spot - full wide behind, and a crop of the subject at full tele in the circle.



## IMAGE QUALITY & PERFORMANCE - NIKON COOLPIX P900

In terms of reach, there certainly is no beating the CoolPix P900. The 83x optical zoom brings you an optical zoom equivalent of a 2000mm telephoto lens, in a decidedly smaller and lighter package. Focus is fairly fast even at the full extents – on par with the Powershot G3 X but slower than the Lumix DMC-FZ300. Like the G3 X, the CoolPix P900 has a feature where pressing a button zooms out temporarily to let you find your subject before zooming back in (with focus), which certainly helps with framing your subject. There isn't RAW support on the camera, and the 7fps burst mode is also slightly limited in the sense that the buffer fills after seven shots, but the bigger factor is that images at max zoom tend to be a little soft. However, if you really want telephoto reach without the investment of a full DSLR and lens, then there's nothing else quite like it.



The CoolPix P900 retains just about enough detail to be usable at ISO 1600.



The images of the CoolPix P900 are a little soft at the extreme tele end.

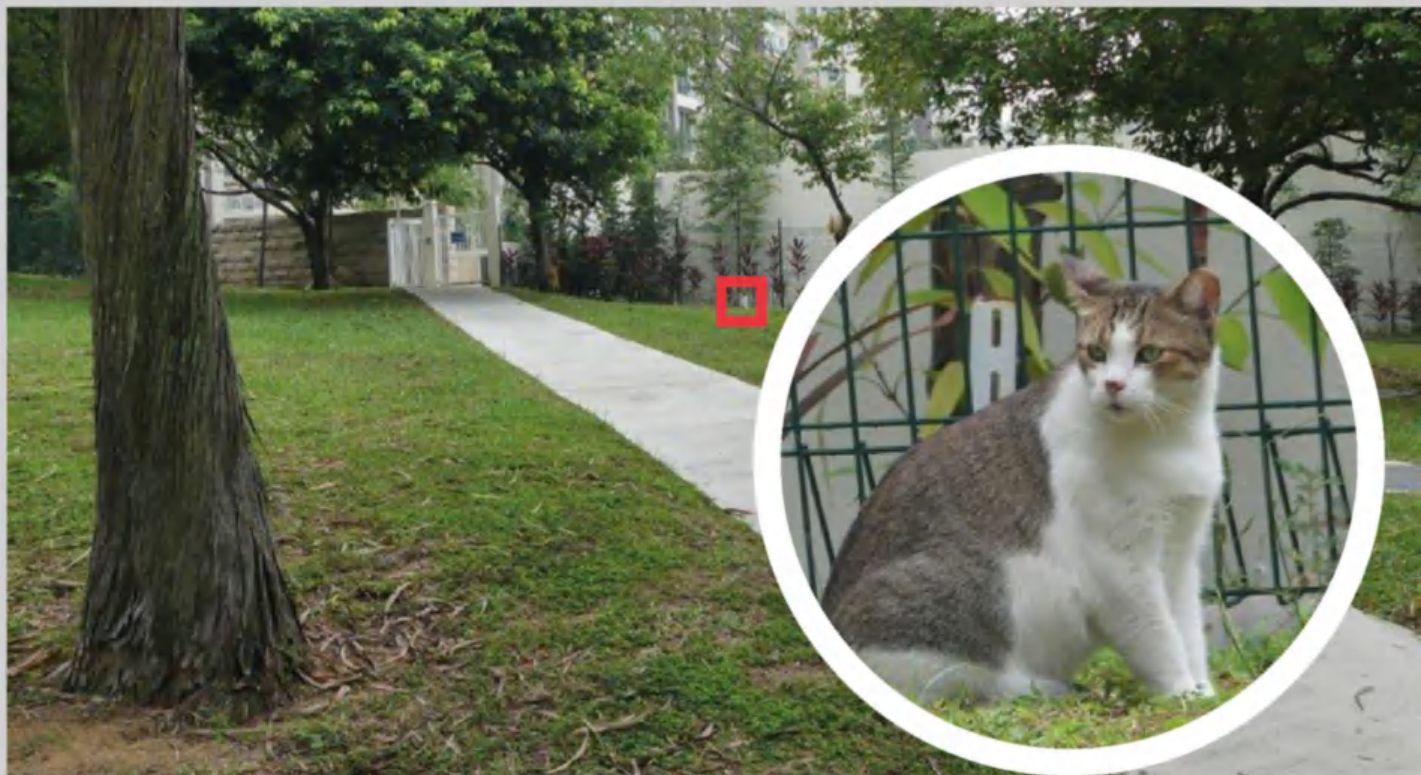


## IMAGE QUALITY & PERFORMANCE - PANASONIC LUMIX DMC-FZ300

The Lumix DMC-FZ300 has the best handling of the group. The Hybrid OIS also made it the easiest to use across the entire zoom range, keeping the live view display stable enough to use for composition at its extremes, thus saving you from zooming out. It's also great up close, with a macro function that lets you focus on objects with a minimum focus distance of just 1cm. Autofocus speed was miles ahead of the other two; thanks to Panasonic's Depth from Defocus technology. And we liked the implementation of the 4K burst photo modes, as pulling out select frames from a video clip is certainly easier than trying to time the shot just right. Importantly, the 8-megapixel (3,840 x 2,160) images you get from these modes are still large enough to be usable for prints. Finally, the Lumix DMC-FZ300 also offers the best video functions, with 4K at up to 30p and a microphone input for better audio recording.



Images up to ISO 1600 are very usable with a little sharpening.



Two pictures from the same spot - full wide behind, and a crop of the subject at full tele in the circle.



MODEL	CANON POWERSHOT G3 X	NIKON COOLPIX P900	PANASONIC LUMIX DMC-FZ300
SENSOR SIZE	1-inch type	1/2.3-inch type	1/2.3-inch type
EFFECTIVE PIXELS	20.2-megapixels	16.1-megapixels	12.1-megapixels
ISO SENSITIVITY	125-12,800	100-6,400 (12,800 available in monochrome mode)	100-6,400
FOCAL LENGTH	24-600mm optical, 35mm equivalent	24-2000mm optical, 35mm equivalent	25-600mm optical, 35mm equivalent
MAXIMUM SHUTTER SPEED	f/2.8(w) -f/5.6(t)	f/2.8(w) -f/6.5(t)	F2.8
MAX APERTURE	1/2000	1/4000	1/4000, mechanical, 1/16000 electronic
MAX CONTINUOUS FRAME RATE	5.9 fps	7fps (JPEG Normal)	12 fps, (JPEG H, AFS)
FLASH	Yes	Yes	Yes
MAX MOVIE RESOLUTION	1,920 x 1,080	1,920 x 1,080 (60p)	3,840 x 2,160 (25p)
WI-FI	Yes	Yes	Yes
VIEWFINDER	No (additional purchase)	0.2" LCD with diopter adjustment, approx 921k dots, approx 100% field of view	0.39" OLED LVF, approx 100% field of view, 1,440K dots
MONITOR	3" vari-angle TFT-LCD with touch, approx. 1.620 million dots	3" free-angle TFT LCD with approx 921k dots	3" free-angle TFT LCD with touch
SIZE	123.3 x 76.5 x 105.3 mm	139.5 x 103.2 x 137.4 mm	131.6 x 91.5 x 117.1 mm
BATTERY LIFE	Approx 300 images	Approx 360 shots	Approx 380 shots
WEIGH (INC. BATTERIES)	733g	899g	691g
PRICE	\$1,199	\$889	US\$599 (about \$910)



# AND THE BEST BRIDGE CAMERA IS...



## PANASONIC LUMIX DMC-FZ300

This was a really close call between all three cameras as each offered something the others didn't. The CoolPix P900 obviously had the greatest reach, albeit at reduced quality towards the extremes. The Powershot G3 X on the other hand, had the best image quality thanks to the larger sensor. Where the Lumix DMC-FZ300 stands out however, is in how it is consistently good across the board. You can obviously go far with it – the in-body stabilization helps greatly in getting a stable image – but you can also go extremely close-up thanks to the minimum focusing distance of just 1cm. Crucially though, is how much better the autofocus performance is and the ease of use of the camera overall. Despite the slightly lower image quality due to a smaller sensor, its overall set of features, ease of use and performance won us over.

## AT A GLANCE

## Functions

Altimeter, barometer, temperature sensor, digital compass, 1/100sec stopwatch, multi-band 6 auto time calibration, world time, auto calendar

## Power

Tough Solar

## Water resistance

200M

## Weight

119g

## Price

\$899



Curved lug wings provide a better fit by reducing wrist gap, allowing the Mudmaster to fit even small hands too.

## CONCLUSION

Probably the best looking, well thought out and most functional G-Shock to date.

TESTED & RATED

9.0/10

HWM  
SINGAPORE

# GORGEOUSLY RUGGED

## Casio G-Shock Mudmaster GWG-1000

The GWG-1000

"Mudmaster" is the latest in the G-Shock Master of G series. For those not familiar with the nomenclature, Master of G watches tend to be designed for specific uses identified by its prefix, such as "frog", "range", "gravity", etc. followed by a "master" or "man" suffix to identify if it is analog or digital. Hence, the Mudmaster is an analog G-Shock designed for harsh ground environments with specific protection against mud and grit.

And a good thing too if you love Casio's analog offerings more than their digital counterparts, because the Mudmaster is absolutely gorgeous. Now, you're going to say that all G-Shocks look similar, which is true, but there are many little tweaks here and there that make the Mudmaster stand out.

While the Mudmaster is an amalgamation of the digital

Mudman and Rangeman series in an analog design, you're essentially looking at a hulking-out and improved Pro Trek PRW-6000 with hints of the Gravitymaster's case and thick watch face styling.

Button configuration is more or less identical to the Pro Trek, except the Mudmaster has a fifth button at the bottom to activate lights; the Mudmaster's hands will also automatically move out of the way of the LCD when you activate any of the sensor readings. What we love about the Mudmaster is that it seemed Casio paid more attention to minute details in its design and construction than they did with the Gravitymaster. Everything from the extra-large buttons to the watch band feature textured detailing that impresses on the whole G-Shock persona.

Functionally, mud and dirt resistance is much improved

from the Mudman with new gasket-type buttons and screw-lock crown construction as opposed to conventional urethane caps; it even blocks out fine dust. A side effect to this is the ability to have exposed buttons, which give the Mudmaster a more solid, rugged appearance rather than the plastic-looking Mudman.

The Ver. 3 Triple Sensor used in the Mudmaster is still the same one found in Pro Trek and Rangeman models. Readings for temperature, barometer and altimeter were fairly accurate and can be a useful gauge, but the digital compass was spot on. The watch is completely powered by Casio's Tough Solar tech and the only thing that's really missing is GPS time correction like the Gravitymaster. The Mudmaster only supports multi-band 6 radio syncing.

by Zachary Chan



TAP FOR  
GALLERY



TEST  
EDITOR'S  
CHOICE  
HWM  
SINGAPORE



# THE NEW MAINSTREAM CARD

## PowerColor PCS+ R9 390

The PowerColor PCS+ R9 390 sports the same Hawaii silicon as the Radeon R9 290. But compared to its predecessor, the amount of GDDR5 memory has been doubled here to 8GB in a bid to help the card keep up with ultra-high resolution gaming.

Clock speeds on the ASUS card have also been bumped up to a 1,010MHz core clock and 6,000MHz effective memory clock, representing just a tiny speed boost over the 1,000MHz reference core clock.

Like the more powerful Radeon R9 390X, it is powered by one 6-pin and one 8-pin power connector, and you'll need at least a 550 watt power supply. PowerColor uses a triple-fan custom cooler to tame the Hawaii GPU beneath.

As expected, the cooler's fans are of the semi-passive

variety, and are set to power down when the GPU's temperature is below 60°C. That pretty much translates into any time that you aren't gaming, so in the rare occasion that you're actually working at your rig, you'll get the silence that you need.

In the performance department, the Radeon R9 390 fares well against the GeForce GTX 970 – its closest competitor in this price range. In Middle-earth: Shadow of Mordor, it was 19% faster than the latter card at a resolution of 2,560 x 1,600. Shadow of Mordor is quite a bandwidth-intensive game, and it looks like AMD's strategy to boost memory capacity in order to increase bandwidth is paying off.

However, it trailed the GeForce GTX 970 by a small margin in Crysis 3, most notably at 1200p with anti-

aliasing turned off. Clearly, the newer card isn't always the better one. From what we observed, the NVIDIA card consistently performs better at 1200p resolutions.

Thermal performance is actually fairly decent for a Hawaii GPU, and the card posted a peak temperature of 65°C, probably owing to its lower clock speeds and pared-down Hawaii core. It even ran 11°C cooler than the Palit GeForce GTX 970 Jetstream, so it looks like PowerColor's cooler is doing quite a good job.

Overclocking capability was average, and we managed to boost the core clock to 1,090MHz and effective memory clock to 6,400MHz, which resulted in a 6% gain in 3DMark 2013, more or less on par with the GeForce GTX 970.

by Koh Wanzi

### AT A GLANCE

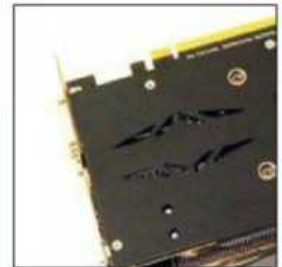
**GPU Transistor Count**  
6.2 billion

**Core Clock**  
1,010MHz

**Memory**  
8GB GDDR5

**Memory Clock (DDR)**  
6,000MHz

**Price**  
\$519



As with most graphics cards these days, a brushed metal backplate helps with structural stability.

### CONCLUSION

**Good value and performance relative to more pricey competitors; best suited for gaming at 1600p and up.**

TESTED & RATED

**8.0**<sub>/10</sub>

**HWM**  
SINGAPORE



# A MOUSE FOR EVERY GAME

## Roccat Nyth

### AT A GLANCE

#### DPI

Up to 12,000

#### Polling Rate

1,000Hz

#### Buttons

Customizable

#### Size

Customizable

#### Weight

Varies

#### Price

\$229



You can even customize the thumb zone with special plates you can order off Roccat's site.

While there have been countless mice that cater to a specific gaming genre or another, no mouse can claim that they'd function well in every genre out there. That is, until the Nyth. True, the Nyth has issues, but it's the closest thing we've seen to a mouse that plays well in every genre conceivable.

With 5 fixed buttons and 12 customizable buttons, the Nyth isn't a normal mouse. That's even more evident when you look at the specs of the device. While its 1,000Hz polling rate might make it similar to the Roccat Tyon, the Nyth's 12,000DPI laser sensor is one of the most sensitive in the world, matched only by Logitech's Proteus Core. Sadly, one of the drawbacks to the Nyth is that it is wired, which means if the cord gets damaged or malfunctions, cord replacement will not be possible.

The biggest draw to the Nyth is its extreme button reconfiguration support.

Weirdly, as customizable as the Nyth is, it doesn't offer weight customization. While you can offset that to a certain extent with what sidegrips and how many buttons you use, it's still a noticeable omission.

There's a section on the mouse called the Modular Thumb Zone where you can swap in and out buttons to your heart's content. The Nyth has twelve customizable sockets and unlike other mice, you can use any of the twelve sockets at once, none of them or a mixture of buttons to suit your play style.

Playing an MMO and need a whole slew of shortcuts for the Hotbar? Plug in all 12 of the thumb zone buttons and never reach for your keyboard's number keys again. Playing an FPS and need a streamline mouse without extra buttons? Remove all the thumb zone buttons and just use the basic integrated buttons instead. It's up to you.

By the default, the Nyth

comes with four different thumb zone button types. Two of them function as buttons and you can mix and match both types. The other two types are simply covers you can use to close the unused sockets in the thumb zone.

On top of that, the Nyth also comes with two different sidegrips. There's a bigger one (with finger rest) for those who prefer larger mice and a slimmer one for those who want their mice small. Both attach securely via magnets and work great, though the bigger one (with the finger rest) does need some getting used to; we kept thinking the finger rest was a mouse button and tried pressing it by mistake.

Roccat even offers the ability to buy more buttons or customize your own buttons via its 3D Library service. You can order extra buttons online but if you have a 3D printer, you can just download the plans from Roccat's site and create them





The Modular Thumb Zone sockets are labeled, making button placement easy. You can't place a wrong button into a socket as each of them will only fit their correct socket.

#### CONCLUSION

**The Nyth might be pricey and it has some kinks left to be worked out, but it is one of the best premium gaming mice for any genre.**

yourself.

Sadly, the biggest issue with the Nyth is the buttons themselves. Rather, the buttons tend to get stuck even when released from their sockets. There's a slider underneath the mouse you push to release all the thumbzone buttons, but most times, a couple of them will get stuck and you'll have to pry them out. Also, while the sockets will only accept buttons meant for that particular socket, sometimes getting the right button into the right socket can take some doing.

Other than the thumb zone, the Nyth also comes with the Dorsal Fin button (placed right below the mouse wheel) that was last seen on the Roccat Tyon. Also like on the Tyon, we found the Dorsal Fin awkward to use and wished that Roccat had integrated the Tyon's X-celerator paddle instead.

The Nyth also has Roccat's Easy Shift [+] functionality, which is a modifier button that lets you assign alternate

functions to any of the available keys. While the Nyth isn't exactly short on keys, the option to have more keys without taking up physical space is always welcomed and Easy Shift [+] performs as well on the Nyth as it does on any of Roccat's previous products.

All of the buttons on the Nyth are easily accessible (save for the Dorsal Fin mentioned earlier), though to fully appreciate the Nyth, one has to be a Palm grip user. While Claw and Fingertip users can still use the mouse, they might find the thumb buttons a bit awkward to hit properly. Needless to say, with the modular thumbzone embedded on the left side of the mouse, the mouse isn't built for left-handers.

Releasing concurrently with the Nyth is the Swarm, Roccat's newest customization utility which is compatible only with the Nyth now, though should support future products too. While the Swarm is new, setting up the Nyth and

customizing it is easily done, thanks to the intuitive menus in the utility. If you're familiar with other customization utilities like the Logitech Gaming Software or AlienFX, you'll have no problems with the Swarm.

There's nothing like the Nyth in the market right now. While the mouse is definitely an investment at \$229, if you're serious about PC gaming, the Nyth is one of the best mice in the market right now. It's not perfect, but with its ability to be customized in a boatload of ways, it comes closer than any other mouse has come before functionality-wise.

by Salehuddin Husin

TESTED & RATED

**8.5**<sub>/10</sub>

**HWM**  
SINGAPORE



# THIS IS THE TABLET YOU'VE BEEN WAITING FOR

## Apple iPad Mini 4

### AT A GLANCE

**Operating system**  
iOS 9

**Display**  
7.9-inch 2,048 x 1,536 pixels (324ppi) IPS LCD

**Processor**  
Apple A8

**Storage**  
16/64/129GB

**Price**  
From \$548

Last year's iPad Mini 3 wasn't much of an upgrade. In fact, the only thing that changed from the Mini 2 was the inclusion of Touch ID. Then at this year's iPhone 6s launch event, its successor the iPad Mini 4 was given about 20 seconds of on-screen time.

Despite Apple's seeming lack of love, the iPad Mini 4 actually has actually changed quite a lot. It's quite a bit slimmer than its predecessor, going from 7.5mm down to a razor thin 6.1mm. That makes it skinnier than competitors like the Sony Xperia Z3 Compact Tablet. This is a huge reduction in thickness - just for comparison the iPhone 6 is 6.9mm. It's also lighter

than last year's model, with the WiFi model weighing a mere 299g, and the 4G LTE model coming in at 304g. Unfortunately, the new Mini is also a tiny bit taller, 3.2mm to be precise. This isn't much, but it's just enough to make most cases for the previous Mini's no longer fit.

Other than the change in dimensions, the Mini 4 looks almost identical to its predecessors. There are only two changes from last year's model: the removal of the orientation lock / mute switch (you'll need to swipe up and access the Control Center for those two options now) and the speaker grill has gone from two rows of holes to one (it looks just like the iPhone 6 now).

The design still looks premium, and it's still the nicest-looking mini tablet out there. Having said that, it is starting to look a bit dated, especially when compared to the iPhone 6 and 6s. We haven't seen chamfered edges on the iPhone for over a year now and it's probably time Apple updated the iPad line to follow suit. Color choices remain the same as last year with Space Gray, Silver, and Gold versions available. Tragically, there's no Rose Gold option to match your new iPhone 6s.

The rear camera on the Mini 4 has been improved. The new module is 8-megapixels, which puts it on par with the iPad Air 2. The new camera is actually





The orientation lock / mute switch is gone from the Mini 4.



The Mini 4 is the thinnest tablet available right now.

#### CONCLUSION

**This is the tablet Apple should have released last year.**

pretty good, and takes great pictures in decent lighting. Unfortunately, it still lacks an LED flash, so you won't be able to take photos in low light.

The front-facing 1.2-megapixel FaceTime HD camera has also been upgraded to perform a bit better in low light, but it doesn't compare to the new 5-megapixel front camera on the iPhone 6s.

While the Air and Mini both share the same screen resolution - 2,048 x 1,536 - Apple's smaller iPads have always lagged behind their bigger counterparts in terms of color reproduction - until now. Apple has fitted the iPad mini 4 with a gorgeous, vibrant display that's on par with the iPad Air 2 and a massive step up from the Mini 3. The difference is huge: The Mini 3 could show only 67.3 percent of the sRGB gamut; the Mini 4 now hits 99.8 percent. For the first time, the Mini's display is also fully laminated, which

means Apple has eliminated the air gap between the Retina LCD and the Mini's glass screen. There's also a new anti-reflective coating that makes the iPad Mini easier to use outdoors and under bright lights. All of these improvements result in the best display we've seen on an iPad Mini so far.

The Mini 4 is running on Apple's dual-core A8 processor, which is much faster than the A7 in last year's model, but not quite as good as the A8X in the iPad Air 2. The Mini 4 is also using a dual-core 1.5GHz Typhoon GPU, whereas the iPad Air 2 has a Triple-core 1.5GHz Typhoon GPU. Like the iPad Air 2, the Mini 4 has 2GB RAM, up from 1GB on the Mini 3, which makes transitions smoother and helps with multitasking.

Due to its thinner profile, the Mini 4 has a smaller 5,124mAh capacity battery. That's quite a reduction from the 6,470mAh battery found in the Mini 3. Despite this,

the Mini 4 actually lasted longer, running for six hours and forty-two minutes in our video looping battery test. If you're just using it for web browsing, you'll get about ten hours out of it.

The iPad Mini 4 may still look the same as its predecessors, but otherwise it's better in every way. It is the best display Apple has put on a small iPad, which by itself is enough of an upgrade over the older Mini 2 or 3. You also get much faster performance, better battery life and an improved camera too.

by James Lu

TESTED & RATED

**9.0**<sub>/10</sub>

**HWM**  
SINGAPORE



TAP FOR  
GALLERY

## AT A GLANCE

**Operating system**Android 6.0  
Marshmallow**Display**5.7-inch 2,560 x 1,440  
pixels AMOLED**Processor**Qualcomm Snapdragon  
810 v2.1 octa-core  
processor**Weight**

178g

**Dimensions**

159.3 x 77.8 x 7.3mm

**Price**

From \$949



The Nexus 6P is equipped with a USB Type-C port for charging.

# THE BEST NEXUS YET

## Huawei Nexus 6P

It's time to throw everything you thought you knew about Nexus phones out the window. For the first time, we're actually interested in a Nexus as a worthy piece of hardware. And that's discounting the warm, gooey bit at its core that is Android 6.0 Marshmallow.

With the Nexus 6P, Google and Huawei have finally made a Nexus phone that can truly be called premium. Build quality feels absolutely top-notch, and we'd put its all-aluminium body in the same league as Samsung's latest Galaxy line of phones. Rumors about spontaneous cracking of the camera window and an unflattering bend test notwithstanding, these so far remain unsubstantiated, and we really wouldn't worry too much about them.

The screen is an AMOLED display with a resolution of

2,560 x 1,440 pixels, which translates to a pixel density of 518ppi. This puts it slightly behind phones with smaller displays like the Galaxy S6 (577ppi), but on par with the Galaxy Note 5. In fact, the team behind the Nexus 6P confirmed that it uses the latest generation display panels from Samsung, so it might very well be the same as that used on the Note 5.

As is typical of AMOLED screens, colors can appear a tad bit oversaturated, which should endear it to those who prefer vibrant, punchy colors. However, if you enable the sRGB color mode, the colors immediately become more muted but also more accurate, which is just the way we like it.

The front-facing stereo speakers are also a welcome feature, but while they were certainly loud enough, they were otherwise

unremarkable.

One of the standout features on the Nexus 6P is its excellent fingerprint sensor, dubbed Nexus Imprint. The lack of a home button means that the sensor has been relocated to a nifty little depression on the back of the phone. You may need some time getting used to it if you're used to a home-button sensor, but you'll eventually find that the new placement is a cinch.

The sensor's performance was also just about flawless. In our time with the phone, it read and registered our prints in a heartbeat, regardless of the orientation. In fact, we found that we didn't even have to perfectly cover the sensor to get our print recognized.

Another key implementation is a USB Type-C port for charging and data transfer (only USB 2.0



The Nexus 6P Imprint fingerprint sensor works exceedingly well.

#### CONCLUSION

**Finally, a Nexus phone with the hardware and performance to complement the latest version of Android.**

speeds, sorry). The reversible design is a welcome improvement over micro USB for sure, and USB Type-C offers 15 watts of output which can get the phone from zero to a full charge in about an hour and 40 minutes. However, USB Type-C devices aren't that common yet, which means that USB Type-C cables are still something of a rarity. So if you forget your cable, or if you lose it, you cannot just borrow one from anybody.

We also have to single out the camera, which stands out because it is the first on a Nexus phone to not be entirely outclassed by rival flagships. The 12.3MP rear camera comes with laser autofocus and a large 1.55µm pixels sensor to capture more light, and it also proved fairly adept at capturing close-up shots, better even than the built-in lens blur function. We preferred the camera with HDR+ mode off – pictures turned out better without it as its ability to properly balance light and shadow appeared

wonky and inconsistent.

Overall, we were quite pleased with the camera as the level of detail was good and colors were accurate. However, we were disappointed with the lack of optical image stabilization (OIS) as the large size of the phone sometimes proved too much for our shaky hands.

In our battery tests, the 3,450mAh non-removable battery on the 6P unfortunately failed to keep up with the Galaxy Note 5's smaller 3,000mAh battery. It lasted 704 minutes while looping video and streaming data, over three hours behind the Note 5 (although it did outperform considerably smaller phones like the iPhone 6s). This was likely due to the Snapdragon 810 v2.1 processor's inability to keep up with the more efficient Exynos 7420 processor.

Performance-wise, the Adreno 430 GPU on v2.1 of the Snapdragon 810 SoC edged ahead of the Mali T760 MP8 GPU on the latest Samsung phones in 3DMark,

topped only by the new A9 processor in the iPhone 6s Plus. However, its strong gaming performance was not matched by its overall CPU, I/O, and GPU performance, where the 6P fell behind Samsung phones equipped with faster UFS 2.0 storage and the Exynos 7420 SoC.

But number-crunching aside, the Nexus 6P was overall very zippy and fast, with no perceivable slowdowns in day-to-day use. This is looking very much like the moment when Google truly transitions from software vendor to hardware competitor.

by Koh Wanzhi

TESTED & RATED

**8.5**<sub>/10</sub>

**HWM**  
SINGAPORE







# THIS IS HOW YOU MAKE A ROUND SMARTWATCH

## Samsung Gear S2

### AT A GLANCE

**Operating system**  
Tizen OS

**Display**  
1.2-inch, Circular Super AMOLED, 360 x 360 (302ppi)

**Processor**  
Qualcomm MSM8x26

**Compatible with**  
Android 4.4 KitKat or newer with at least 1.5GB RAM

**Price**  
\$448 (Gear S2)  
\$548 (Gear S2 Classic)

There are plenty of round-faced smartwatches out there, but what makes them different from square-faced watches? Nothing, the round-face is all for show. Sure, they look nicer, but because Android Wear is the same OS across all devices, the UI and features can't take advantage of the form factor.

The Gear S2 is different. Samsung's own Tizen OS lets it stand out from all the Android Wear-based smartwatches out there. The Gear S2 actually takes advantage of its shape, from its circular rotating bezel all the way down to how you navigate through the interface.

There are two models of the S2 available, the standard model, which has a sleek modern finish, and

the Gear S2 Classic, which costs \$100 more and has more traditional styling, with a leather strap and a knurled bezel.

Fit and finish on both models is top notch, with a matte, stainless steel case on the Standard, and a glossy stainless steel on the Classic. One difference between the two models is that the Standard version uses Samsung's proprietary straps, while the Classic will take any 20mm watch strap.

The star attraction of the Gear S2's design is its rotating bezel. The ceramic bezel rotates left or right with a light tactile click, and acts as your main interaction point with the watch, letting you easily navigate from app to app, or to scroll up and down when you're inside an app itself. On the Classic, the

ridged edges let you grab onto the side of the bezel and rotate it like you would a diving watch, whereas on the regular model, you use your finger to apply pressure to the top, sort of like an iPod scrollwheel.

Navigating with the bezel is incredibly intuitive and it just feels so right for a watch, I'm honestly amazed that no-one has thought of it before. Compared to smartwatches with touchscreen-only input, or even the Apple Watch's small rotating crown, the Gear S2 feels a lot less fiddly to use.

Both models use the same 1.2-inch circular Super AMOLED display with a 360 x 360 pixels resolution, resulting in a pretty sharp 302ppi. Colors look bright and vivid, easy to read both indoors and out, has excellent



TAP FOR  
VIDEO



There's a Back and Home button on the side of the Gear S2.



The Gear S2 Classic has a knurled bezel, similar to a diving watch.

#### CONCLUSION

**If you can live with the limited apps available, the Gear S2 is one of the best smartwatches available.**

viewing angles, great contrast and deep blacks.

The Gear S2 isn't as feature-filled as its predecessors; there isn't a camera and you can't make phone calls via speakerphone. What you do get: message notification, information apps, fitness tracking, playing music via the internal 4GB storage through a paired Bluetooth wireless headset, and respond to messages or trigger voice-activated actions using a built-in microphone. The watch vibrates but there's no speaker.

Still, Samsung has done a really good job of streamlining the UI and making it intuitive and easy to use. Turn the bezel to the right from the main watchface and you can scroll through information widgets like your physical activity for the day or the weather, and turn it to the left to see your notifications. Notifications can be filtered and are interactive, just like on Android Wear. You can respond to incoming messages with preset

responses, voice dictation, or tap out a response on a miniature keyboard.

Two buttons on the side of the watch also aid navigation, the top one is a back button, while the bottom one acts as a home button and brings you back to the watchface.

The biggest drawback to the Gear S2 is the lack of apps. Running on Tizen restricts it to a limited library of compatible Gear apps, and many of the big names are missing right now. Nike has its own watch face, and there's an ESPN app for sports scores, but you won't find Facebook, Twitter or Uber here. One move Samsung has made towards getting more developers on board with Tizen is making the S2 compatible with any phone running Android 4.4 KitKat or newer with at least 1.5GB RAM.

The standard Gear S2 has a 300mAh capacity battery. The S2 Classic actually has a smaller 250mAh battery, but surprisingly, we didn't notice any significant difference between the two watches in

terms of battery life. On both watches, battery life was better than expected, and you can easily go two days of light use without a recharge.

Overall, the Gear S2 is well-designed, stylish, innovative, elegant and easy to use. It has the best display I've seen on a smartwatch and it has, by far, the most natural and intuitive way of interacting with your smartwatch so far. It's the best round-faced smartwatch I've used; but not the best overall smartwatch. The apps just aren't there right now, and without that ecosystem backing it up, it's missing a huge part of the smartwatch experience.

by James Lu

TESTED & RATED

**8.5**<sub>/10</sub>

**HWM**  
SINGAPORE



# NOT ALL CHAIRS ARE CREATED EQUAL

## Secretlab Omega

### AT A GLANCE

#### Material

PU leather cover and aluminium base

#### Weight limit

110kg

#### Price

\$499



The red stitching on the Omega looks really good in the flesh.

### CONCLUSION

**A supremely comfortable chair that doesn't entirely break the bank, the Omega will work well in either your home or office.**

What can one do to improve a chair? As it turns out, a huge lot. The Secretlab Omega is a radically overhauled chair that surpasses all our expectations. The Omega is unabashedly going after the more premium segment of the market, all while doing its best to stick to Secretlab's ethos of offering quality products at a reasonable price.

Secretlab tells us that they've made zero compromises with this chair, and that certainly looks to be true. The first thing we noticed about the Omega is its extra-thick layer of cold-cure foam. Having used both the Throne V1 and the DXRacer Formula series chair for extended periods, we can safely say that the additional padding on the Omega makes a huge difference.

The cushioning is much softer and generally feels more luxurious. There is more give on both the seat and backrest, which is

probably what contributes to the overall more comfortable experience. The PU leather on the Omega is also of a noticeably higher quality, and it is both softer and more supple than what we've come to expect from its ilk.

In addition, the head and lumbar pillows are much improved. They've been upgraded with denser stuffing and now provide much firmer support. The head pillow is also quite large – good news if you've

got a large noggin on your shoulders. However, one thing to note is that the lumbar cushion is no longer adjustable because of the lack of cutouts in the head rest. This means that there's no longer space through which to route the adjustment straps, so the cushion can only sit at the base of the chair.

The other major upgrade is the new four-directional, or 4D, armrest, which can be shifted along all the axes, thus allowing for quite an impressive range of adjustments. They also feel wonderfully solid, and we particularly like the option for front and back adjustments because we can now sit closer to our desks.

Furthermore, gone is the cost-saving nylon base on the Throne V1. The Omega now sports a hefty aluminium base that feels and looks far better. On top of that, the tilt mechanism has been overhauled entirely. Not only can you rock back and tilt the chair, you can also lock it at your desired tilt angle by turning the left adjustment lever down. The new mechanism also makes it much easier to tilt the chair while the backrest is upright. Finally, the backrest can be reclined by about 155° – this is actually further than it sounds. This is a chair for both serious work and play, and also naps.

by Koh Wanzhi



TESTED & RATED

**9.0**<sub>/10</sub>

**HWM**  
SINGAPORE





FEATURE

# CONFIDENTIAL REPORT: TECH IN 2015

Every year, products are updated with new technologies that promise to be faster, better, <insert preferred adjective here>, than previous generations. How do they actually fare when they are released? Here's our opinion of the tech industry.

Text by *Team HWM* • Illustration *Don Low* • Art Direction by *Ken Koh*



## CATEGORY: SMARTPHONES

### GRADE: C+

A year of spec upgrades with only marginal benefit to the consumer, saved by some promising new features from Apple and Microsoft. But it's still too early to know if 3D Touch and Continuum will revolutionize the smartphone.

## STAND OUT TECH OF THE YEAR:

### APPLE IPHONE 6S/6S PLUS

The iPhone 6s doesn't stand out for its design – sure it looks nice, but it's identical to last year's model, its LCD display – Samsung has it beat here with the Note 5's absolutely gorgeous Super AMOLED panel, or even its improved 16-megapixel rear camera – both the LG G4 and Samsung Galaxy Note 5 put up fierce competition here. Nope, it deserves special mention here solely because of 3D Touch, the game changing technology that, if it becomes widely adopted, could shape up to be Apple's best ever innovation (sorry Siri).

# IS THIS AS GOOD AS IT GETS?

2015 was a disappointing year for many smartphone enthusiasts. Google failed to deliver on its Project Ara modular smartphone concept, and Qualcomm was plagued with overheating controversies with its flagship Snapdragon 810 processor. Worse still, there's a growing sentiment that today's devices are so good, there's no room for real improvement. Every time a new device is launched, detractors point to incremental upgrades or gimmicky features rather than true game-changing technology. Has mobile technology hit an innovation plateau? Is this really as good as it gets?

A few years ago when phablets first started hitting the market, it seemed like every few months somebody would release an even bigger phablet, as brands continually one-up'd each other. In 2015, almost everyone has settled on two sizes: 5-inches and 5.5-inches. Now the war seems to have turned to display resolution. LG started it last year with the G3, which boasted the world's first 2,560 x 1,440 pixels resolution QHD display. This year, Samsung also adopted QHD as its resolution of choice, which we saw on the S6, S6 Edge, S6 Edge Plus and Note 5, and in September, Sony took the resolution war to the next level when it revealed the Z5 Premium, a smartphone with a ridiculous 4K display at 3,840 x 2,160 pixels resolution. That's 806 pixels per inch by the way, all on a 5.5-inch screen. While this all sounds great, the actual benefit to the consumer is questionable. At this size, most people won't even be able to tell the difference on a display past 400 or so pixels per inch – which is the level of most Full HD displays – and remember also that more pixels means higher power consumption, which means shorter battery life.

So if increasing pixel density isn't the answer, what is? Apple has stubbornly stayed out of the pixel game, with the iPhone 6s Plus using a modest Full HD display, and the 6s fitted with a positively pedestrian 720p display. But it's the

technology Apple has developed behind the display that might be 2015's saving grace. 3D Touch is the signature feature of the iPhone 6s and 6s Plus, and is without a doubt the biggest breakthrough technology in smartphones this year. Together with Corning, Apple developed a pliable cover glass for the iPhone 6s. Swipe it, and the phone works the way it always has. But press it, and 96 sensors embedded in the backlight of the display measure microscopic changes in the distance between themselves and the glass. Those measurements

then get combined with signals from the touch sensor to make the pressure of your finger sync with the image on screen. Essentially, 3D Touch introduces a second way to interact with your touchscreen. It enables shortcuts, secondary functions, and pressure-sensitive controls. It's a right-click for your smartphone. In fact, we'd go as far to say that it's the single biggest improvement to the touchscreen since its creation. And with a few Android-developers, including Samsung and Xiaomi, now saying that they're working on a similar technology for their next phones, 3D Touch looks like it could be the next big thing.

Finally, there's one more player we've had our eye on this year: Microsoft. Surprised? Since acquiring Nokia two years ago, Microsoft has mostly focused on entry-level and mid-range Lumia handsets. But that

looks set to change with the introduction of the Lumia 950 and 950 XL, specifically because these two handsets are the first to include a little feature called Continuum. One of the big problems facing consumers today is having too many devices, all of which run on their own OS. That might soon change however with Continuum, a feature that will turn Windows 10 phones into full-blown PCs when they're connected to displays. You'll be able to connect peripherals to your smartphone and turn it into a mini laptop, or plug it into a display and turn it into a full PC. The day may come when the only device you need is your Windows 10 smartphone.

**"3D TOUCH IS THE SIGNATURE FEATURE OF THE IPHONE 6S AND 6S PLUS, AND IS WITHOUT A DOUBT THE BIGGEST BREAKTHROUGH TECHNOLOGY IN SMARTPHONES THIS YEAR."**





## CATEGORY: GAMING GRADE: C

The games were decent but most of the AAA titles failed to live up to the hype. Metal Gear Solid V and Halo 5 are great games, though nowhere near as great as they should have been. Traditional gaming is on the decline as the rise of mobile gaming continues. With VR coming soon, 2016's gaming landscape might be totally different from what we see now.

## STAND OUT TECH OF THE YEAR: THE WITCHER 3

The Witcher 3 is not only one of the best RPGs of the year (if not the best), it's also one of the best value games out there, especially if you buy the limited edition. For US\$149.99, you get a 33cm statue of Geralt, a high quality steel Witcher medallion, a Steelbook, a 200-page hardcover artbook, the game map, full soundtrack and assorted stickers.

# A LOOK BACK AT GAMING IN 2015

2015 hasn't been exactly a good year for games. The year started off innocently enough though it's mostly been a year of studio closures, cancellations and departures since then.

The year finally saw Nintendo succumb to pressure and start mobile development. While its dabbling in mobile gaming might be in its infancy, this could mean the end of Nintendo handhelds as we know them. The 3DS or its successor might be the last Nintendo portable if the company decides to go the whole hog on mobile gaming. Nintendo's not alone. Konami, another major gaming company, has completely abandoned AAA title development on consoles to focus on mobile games.

The rumor that Sony's stopped first party development on PS Vita games hit fans of the portable hard. Vita stalwarts didn't take it too well; especially considering the portable isn't even four years old yet. Though just a rumor at this point, the signs of Sony withdrawing support for the portable easily visible. First party titles are non-existent, Sony barely acknowledges the machine at trade shows and promotional efforts for the Vita mainly consist of new color schemes. If that's not a death knell for the machine, we don't know what is.

VR's reentry into the general public consciousness is coming, though it's been fraught with delays. Originally slated to hit late 2015, the HTC Vive will now only have limited quantities on sale later this year, with full supply expected only in Q1 2016. With three different headsets set to launch Q1 2016, early adopters will be spoiled for choice.

2015 also saw the return of long dormant franchises, specifically Tony Hawk, Guitar Hero and Rock Band. While the latest Tony Hawk was lambasted for being broken, buggy and visually bland, Guitar Hero and Rock Band were both well received. With the warm reception, expect to see sequels for those series for the foreseeable future. It seems like that gamers have short memories about why they got sick of those franchises in the first place.

Redemption was also on the cards for Destiny. With the Taken King expansion, Bungie's bungled title finally started to live up to expectations. With a completely overhauled gameplay

experience, Destiny 2.0 (another name for the Taken King expansion) made Destiny into a game finally worth playing, a year after it came out. Even better, Bungie's gone on the record saying that all content from here on out will be free; with it charging only for new emotes. That is until Destiny 2 hits late next year.

It was the opposite with Metal Gear Solid V. While the gameplay was exemplary, other aspects of the game were clearly rushed and unfinished; an entire chapter left on the

cutting room floor, as well as the game's original ending scrapped due to time and budget constraints. Needless to say, many gamers were not happy with Konami for releasing an incomplete game.

MGS V wasn't the only hyped title that didn't meet expectations. Halo 5, Microsoft's premiere gaming series, was only a shadow of its former self, with a boring single player campaign with all too familiar settings and enemies. Luckily, the new Warzone mode, REQ system, awesome multiplayer and the promise of free DLC makes up for it.

Thankfully, not all highly anticipated AAA titles were duds. CD Projekt RED's The Witcher 3 not only exceeded expectations, it did so under intense hype. Even with all the pressure, the game was still as great as the developers billed it up to be, despite a drop in visual quality from initial demos. On top of that, CD Projekt RED took it

one step further, with 15 pieces of free DLC, charging only for the two lengthy expansions to the game.

Capcom also shook the gaming world when they decided to buck the trend of having paid DLC. Once notorious for nickel and diming everything from extra costumes to new characters, the company has announced that Street Fighter V, due next year on the PS4 and PC, will have no paid DLC that can't be obtainable through normal gameplay. That even includes all the expansions and other content the company is offering for the whole of Street Fighter V's lifespan. It's a major change that's been met with great positive response from fans and has undoubtedly rejuvenated the jaded fighting game crowd who are used to paying for expansions of their favorite fighting games.

**"THANKFULLY, NOT ALL HIGHLY ANTICIPATED AAA TITLES WERE DUDS. CD PROJEKT RED'S THE WITCHER 3 NOT ONLY EXCEEDED EXPECTATIONS, IT DID SO UNDER INTENSE HYPE."**



## CATEGORY: NOTEBOOKS GRADE: A

Thanks to innovations driven by chipmakers Intel and NVIDIA, there was no shortage of excellent notebooks this year. From the super slim MacBook to the mind-blowing Surface Book, notebooks have never come in more form factors, never been more powerful, slimmer or portable. PCs are making a comeback with notebooks leading the way.

## STANDOUT TECH OF THE YEAR: MICROSOFT SURFACE BOOK

Conceptually, there's nothing new about the Surface Book. We have all seen detachable notebooks before. But what made the Surface Book stand out was that it was its design and specifications. Not only could it be spec-ed with either a powerful Core i5 or Core i7 processor, users can also ask for their Surface Book to come with discrete graphics. This meant that unlike other detachable notebooks, it won't be completely hopeless at gaming. And if users needed extra portability, simply pop the 13.5-inch display off. The display alone has enough battery for a movie or even two.



# SPEARHEADING THE PC COMEBACK

2015 was an exciting year for notebooks, we saw not just one but two new CPU architectures. Well, to be entirely accurate, the first Broadwell CPUs were launched late in 2014 in the form of Intel's new Core M processors. But it was only in 2015 that Intel finally unveiled the bulk of its Broadwell processors, which found its way into many notebooks.

Broadwell was notable because it was a die shrink of the preceding Haswell architecture. It mainly brought about improved graphics performance and much better power and thermal characteristics, which meant notebooks had longer battery lives and notebook manufacturers could build slimmer notebooks. And there was certainly no shortage of super slim and compact notebooks in 2015.

Powered by the Core M processors, 2015 saw two ultraportables in the form of ASUS' excellent Transformer Book T300 Chi and Apple's MacBook. The Transformer Book T300 Chi is a detachable notebook with a tablet display that's a mere 7.6mm - just about as thick as a first generation iPad Air. The MacBook, on the other hand, is a 12-inch super slim notebook that measures 13.2mm at its thickest point before tapering down to just 3.5mm at the opposite end. It also weighs a scant 920g.

Broadwell also gave us extremely competent all-rounder notebooks like Dell's stunning XPS 13. The incredibly slim display bezel and ultra-sharp display aside, the XPS 13's is also immensely compact, taking up as much as 20% less footprint than comparable 13-inch machines. And yet in doing so, it sacrificed no performance and was one of the strongest all round notebooks that we tested in 2015.

Apart from Intel, NVIDIA also contributed immensely to the growth of notebooks in 2015. Earlier this year, it launched its second wave of Maxwell mobile GPUs such as the GeForce GTX 950M, GTX 960M and GTX 965M. These mid-range mobile GPUs soon found their way into many entertainment notebooks and even slim gaming notebooks.

The ZenBook Pro UX501, is an excellent example. It was a

15-inch notebook that measured just 21.3mm thick and weighed 2.27kg. However, it packed an ultra high resolution 4K display thanks to it having an NVIDIA GeForce GTX 960M. For gamers, the Aorus X5 is one of the most compact and powerful gaming notebooks in the market today. Thanks to its twin GeForce GTX 965M GPUs in SLI, it was only 23mm thick and weighed just 2.5kg. Its performance, however, could easily rival that of larger, heavier 17-inch gaming notebooks.

**"THE SURFACE BOOK, IN PARTICULAR, IS A BREATH OF FRESH AIR IN THE NOTEBOOK SPACE AND IS SO NOTEWORTHY AND SPECIAL THAT WE JUST CAN'T WAIT FOR IT TO ARRIVE."**

If you thought all of these were impressive, the second half of the 2015 saw Intel follow up with its new Skylake architecture. In keeping with the zeitgeist of the times, Intel recognized the importance of mobile and focused on improving their chips' power efficiency and thermal characteristics.

The new Skylake processors can throttle between its various P-states more effectively, allowing for greater power savings over time. And some of them also have low rated TDPs as compared to the models that they replaced. Together with the support for more power efficient DDR4 memory, these notebooks will provide longer battery lives than their Broadwell counterparts.

And it's thanks to these Skylake processors that Microsoft could release the double whammy that is

the new Surface Pro 4 and Surface Book. The Surface Book, in particular, is a breath of fresh air in the notebook space and is so noteworthy and special that we just can't wait for it to arrive. Of course, the Surface Pro 4 is no slouch either. It improves on its predecessor in every way. Despite being more powerful, the Surface Pro 4 is both thinner and lighter than the Surface Pro 3.

All things considered, it has been a fantastic year for notebooks. Hybrid and detachable notebooks, which were once considered gimmicky, have really come into their own and are a viable alternative to traditional notebooks. Traditional notebooks, on the other hand, have never been better designed and well-rounded. If anything, 2015 was the year that notebooks really reinvented themselves and proof that you can indeed teach an old dog new tricks.



## CATEGORY: TVS GRADE: C+

A back to the basics year for TVs means that the real fruits of labor will only be seen next year. Ever-changing standards and lack of content remain pain points for end users. But prices have never been lower.

## STAND OUT TECH OF THE YEAR: LG 4K HDR OLED TVS

4K + OLED + HDR. For TV enthusiasts, that's a dream display because OLED seems better poised to render the required HDR light range than LCD. At IFA, LG has wheeled out the EF9500 and EG9200, the company's first 4K OLED TVs to support HDR right out of the box. These TVs are able to render HDR content from streaming services (e.g., Amazon Prime Video) as well as external sources (e.g., 4K Blu-ray players).

# A BACK TO THE BASICS YEAR FOR TVS

TV makers will not admit it, but for the past several years, their smart TV creations had brutally exposed their ineptness in UI and UX designs. After years of quick fixes that led to nowhere, TV manufacturers have now turned to mobile OSes en masse. LG led the charge with WebOS in 2014, and the company followed that up this year with WebOS 2.0. Not to be outdone, cross-town rival Samsung announced that Tizen OS will be the foundation of its smart TV platform moving forward. And across the Sea of Japan, Panasonic has embraced Mozilla's Firefox OS; and Sharp and Sony have jumped onboard Google's Android TV system.

In short, thanks to their mobile underpinnings, my usage experiences with this year's smart TVs are so much more tolerable than yesteryears'. For a start, I'm seeing faster boot times and prettier menus across the board, along with better multi-tasking and device interoperability.

It's also heartening to see that TV makers have turned their attention back to improving picture quality. And I'm not just referring to 4K, which is de rigueur if you want to be seen as a reputable brand these days. In a bid to close the gap between LCD and OLED, several of them, such as Korean pair LG and Samsung, have announced new LCD-LED TVs using Quantum Dot (QD) technology. Put simply, quantum dots are nanoparticles that emit different wavelengths of colors depending on their size. TVs based on this tech tend to produce brighter, more saturated colors than those using regular LED backlights. They also enjoy improved color accuracy and consume less power.

And then there's the new flavor of the year: High Dynamic Range (HDR). Like the HDR mode in many digital cameras and smartphones, it's designed to deliver a picture with a wider range of colors and more details in the shadows and highlights than what's possible on even the best TVs today. There are a couple of ways to get 4K HDR content: one is via streaming services such as those from Netflix and Amazon; the other is via 4K Blu-ray titles. Currently, only Samsung and Sony have committed to issue a firmware update for their current-gen TVs to support 4K HDR.

Indeed, thanks to advancements in display tech and standards, TV makers are enjoying some kind of Renaissance of their own, with many of them harboring the thought of chipping away Samsung's 9-year-strong grip on the TV market. Among them, LG looks to be the busiest. In addition to QD-based TVs, it

also unveiled a proprietary Wide Color Gamut (WCG) tech earlier in the year, which uses different phosphor-based LEDs to realize greater color depth and more lifelike images. Interestingly, the company seems to be making a lot of headway in the mind share and picture quality stakes not so much because of its QD or WCG TVs, but rather, because of its OLED TVs.

You see, before this year, TV enthusiasts who wished to get the very best in picture quality usually had to choose between a 4K LCD TV and a 1080p OLED TV; the former for its high 3,840 x 2,160-pixel resolution, the latter for its super-deep black levels and motion smoothness. But this dilemma no longer exists, thanks to LG's aggressive 4K OLED TV rollout that started in

April with the EC970T. And recently, LG strengthened that lineup with the EG960T and EG920T. In the process, the company's 1080p OLED TVs' prices have dropped considerably, which is good news if you don't care much about 4K.

But make no mistake though: LCD TVs will continue to be the main type of TVs sold in the coming year, 4K or not. Samsung's backlight control is still the best in the business, and Sony's latest Bravias are still sexy as hell. Aided by new tech like Quantum Dot, the display tech that killed plasma still has a lot to offer. For OLED, its main problem is selection, as LG and Panasonic are the only credible ones churning out OLED TVs.

Of course, it's not all hunky-dory in this category. I'm beginning to sound like a

broken record here, but 4K content is still scarce in this region. And HDR, despite its promises, require content producers and broadcasters to get into the act too. So like 4K, our best bet for HDR content is still Netflix and Amazon.

Also, as an Apple TV and Amazon Fire TV user, a part of me still wishes for a giant TV with an awesome panel and tons of HDMI ports, but sans the smart TV bells and whistles. Somehow, the Korean and Japanese TV makers seem reluctant to do so, and this has made me and a few others evaluate other options, like the Xiaomi Mi TV 3. To me, the 60-inch, US\$790 Mi TV 3 is basically a giant 4K monitor, because most of its hardware, like the logic board, content, and sound system, are located in a separate breakout box. If that sounds very similar to Samsung's One Connect implementation for its 4K TVs, that's because it is. However, due to the lack content deals outside of China, Xiaomi is unlikely to sell the Mi TV 3 here officially. This is good news for the Samsungs and LGs of this world, but bad news for consumers.

**"THANKS TO  
ADVANCEMENTS IN  
DISPLAY TECH AND  
STANDARDS, TV  
MAKERS ARE ENJOYING  
SOME KIND OF  
RENAISSANCE OF  
THEIR OWN."**





## CATEGORY: WEARABLES GRADE: B-

Consumers continue to be intrigued by wearable devices, and so it is only a matter of technology catching up to give users what they want. Arguably the most problematic issue plaguing these devices is battery life. Users are loath to give up their wonderful high-resolution color displays, but it is these displays that pose the most significant drain on batteries. But with battery technology not showing much signs of advancement, we can only hope that this is made up for in other areas.

## STAND OUT TECH OF THE YEAR: APPLE WATCH

The Apple Watch is hands down the best watch for your iPhone. But that aside, Apple amazed many industry players by putting out an extremely finely crafted timepiece. It wasn't just a well-made device; it was a well-made watch, period. The quality of the Apple Watch's cases left many stunned, especially those from the luxury watch business. Admittedly, the Apple Watch misses the mark in certain aspects, namely poor battery life and the lack of water resistance being two notable ones, but overall, it was an extremely polished product from a company that had zero experience in watchmaking prior.

# A WHOLE LOT OF HOT AIR

In 2014, they said that 2015 would be the year of smartwatches. Well, it is and yet not quite. 2015 saw the launch of many smartwatches, but none of them were truly revolutionary. This was also true for wearables, as none of the new wearables launched in 2015 really changed the status quo. For sure, they helped advanced the category and introduced some new nifty features, but they did not make wearables must-have kind of gadgets, like smartphones, for instance.

The year kicked off with lots of anticipation as everyone eagerly waited for Apple to launch its smartwatch - the Apple Watch. It was a massive undertaking for Apple which saw them roll out a variety of models, in 38mm and 42mm sizes, and in various cases and straps. Apple, unlike other smartwatch makers before it, knew that a smartwatch needed to be more than just a gadget to attract people. They even went as far as to create solid gold versions of the Apple Watch, in 18k gold and rose gold cases, which cost as much as \$25,000. Mad? You think so, but then Apple went on to sell over four million of these watches and in the process became the number one smart watch brand. Right now, it is estimated that Apple has a 75% market share of the smartwatch market. To put this in perspective, Samsung, who is the number two brand, has a market share of an estimated 7.5%.

However, despite the initial excitement and enthusiasm, sales of the Apple Watch was said to have petered out in the past couple of months. Perhaps most tellingly, Apple CEO Tim Cook chose not to disclose just how many Apple Watches were sold during the report of the company's last quarter's financial results. Though widely regarded as the best smart watch for iOS, the Apple Watch is not without its foibles. Its short battery life and sometimes slow performance made it unappealing to the larger public.

Samsung also took a crack by releasing its new Galaxy

Gear S2 smartwatch. It features suitably high specs like a 1.2-inch circular AMOLED display with a pixel density count of 302 pixels per inch, but what's really outstanding is how you interact with it. Instead of using the crown or swiping on the tiny watch face, users navigate the watch's user interface using the bezel, but turning it left and right. It's intuitive and feels right to use, and it's amazing that no one has thought of it before. It's a simple, but elegant innovation, and makes

it much easier for wears to browse through menus on their smartwatches, but it remains to be seen if other smartwatches will catch on to this.

Pebble, one of the pioneers of this category, also released its new Pebble Time watches this year. It features a new interface called Timeline that arranges your notifications and reminders in a chronological order. It was launched on Kickstarter and the response was overwhelmingly positive. It garnered pledges of over US\$20 million in total. Yet despite its success, the Pebble Time remains a niche product for fans.

In sum, there were major new products in the smartwatch category, but none of them were groundbreaking in the way as say the original iPhone was. Nevertheless, this category of

product remains exciting and it seems that we are all just waiting for the next truly big thing to arrive.

As for activity trackers, the line between them and smartwatches is blurring. The Microsoft Band, for example, is an activity tracker only in name. If you look at its features and what it can do, it rivals many and even exceeds some smartwatches, and poses the question if this is in fact the way forward for smartwatches? That they should give up the watch form factor and instead pursue a more discreet design. Elsewhere, it is pretty much the same old, same old, most activity trackers launched in 2015 continued to count steps and track sleep and have no real innovation to their name.

**"APPLE,  
UNLIKE OTHER  
SMARTWATCH  
MAKERS BEFORE IT,  
KNEW THAT A  
SMARTWATCH NEEDED  
TO BE MORE THAN  
JUST A GADGET TO  
ATTRACT PEOPLE."**



## CATEGORY: CAMERAS GRADE: B+

In terms of just performance alone, the camera industry would probably just get a C+ or B, as the technical achievements of Canon and Sony and tempered by their limited reach on the market. However, throw in the innovation shown by non-traditional camera makers like DJI and Light, and suddenly you have cameras that don't look like or even function like cameras, and that sort of change is certainly worth a higher grade, which is why the camera industry gets a B+ for this year.

## STAND OUT TECH OF THE YEAR: LIGHT L16 CAMERA

This "camera" doesn't look like a camera but rather a smartphone. It houses 16 individual cameras - five with 35mm lenses, five with 70mm lenses, and six with 150mm lenses (all 35mm equivalent) - and fires up to ten of them at the same time with each time, stitching them together to get the final image. The best part? You get the equivalent of true optical zoom because you're not cropping from a single image but putting together up to ten images from at least two different focal lengths.



# FINALLY THE START OF SOMETHING NEW?

Another year, another slew of cameras. This year though, the camera industry saw several firsts. We had the first full-frame camera tuned specifically for astrophotography, two cameras with 35mm full-frame sensors that breached the previous limits of resolution, and the appearance of non-traditional cameras like the DxO One and the Olympus Air, which challenged the notion of what a camera should be with their non-traditional format.

As mentioned, this year is the year that 35mm format Interchangeable Lens Cameras (ILCs) broke the forty-megapixel barrier in terms of resolution, with the Canon 5DS R in particular hitting the 50-megapixel mark, something that was once the sole preserve of medium format cameras and their associated digital backs, which have sensors that are almost twice the size.

That's certainly quite an achievement, especially when you take into account the fact that the camera is still able to reach an ISO sensitivity of 6400 despite the increased pixel pitch. Sony's A7R II on the other hand, reaches "only" 42.4-megapixel resolution, but implements a new back-illuminated sensor design to allow the camera to reach a much higher ISO sensitivity of 102,400 which is certainly impressive.

For some reason though, that sensor design wasn't applied to the A7S II. Traditionally the most light sensitive of Sony's full-frame camera line-up, the A7S series has a lower megapixel count than its A7R sibling and so is able to achieve much higher ISO levels due to the larger pixel pitch, which makes one wonder just how much Sony might have been able to push the limit.

In light of that, the 35mm ILC segment leaves us slightly unsatisfied this year. Sure, medium format resolution in a smaller, lighter format is undoubtedly impressive, but how many of us can afford the cost of these cameras?

The A7R II costs \$4,099 and the 5DS R will put you back \$5,399; quite a bit above what your average enthusiast would look to pay. And besides that, how many megapixels

do you really need? The resolution race has gone to the point where it hardly sets our pulses racing anymore. How many times do you really need to zoom in on to check out Aunt Jane's wrinkles in that last family portrait?

What we're looking for, is true innovation, and thankfully this year we're at least seeing some of that in the form of cameras that are going beyond idea of a the traditional "camera". Take the Olympus Air A01 for example. This "camera" merely consists of a sensor unit with lens mount.

After pairing, your smartphone becomes your control panel and live display, meaning you can place the lens unit anywhere and trigger it remotely.

The DJI Osmos takes this concept and goes one-step further with a focus on video, placing the entire lens and sensor unit on a gimbal stick that adds 3-axis stabilization for steady video on the go. This also uses the large screen of your smartphone for composition, review and control, but comes with a whole host of mounting options that make perfect for videography that might involve motion.

What truly takes the cake though, is Light's L16 Camera, the world's first multi-aperture camera that uses folded

optics and a revolutionary approach to photography to create a smartphone sized camera that has true optical zoom. The L16 has 16 individual cameras in three groups and up to ten of those cameras fire at the same time for every shot you take.

The final image is constructed from a composite of the images taken from all these cameras, and because the cameras are all capturing data at different settings, things like depth of field, ISO and dynamic range can all be adjusted after the fact using computational optics. The final size of the image will fall between 30 to 50MB, which incidentally, is what the full-frame cameras above have just reached, in a much smaller form factor.

That's the type of change we're looking to see, and probably the first real change in thinking for camera makers in a long time.

**"THE L16 HAS 16  
INDIVIDUAL CAMERAS  
IN THREE GROUPS AND  
UP TO TEN OF THOSE  
CAMERAS FIRE AT THE  
SAME TIME FOR EVERY  
SHOT YOU TAKE."**

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LEARN

# A SPY CAM TOOLKIT

Smartphones are slim and so ubiquitous they can go places that a traditional camera can't. The availability of apps have also made them extremely versatile shooters. However, the most common complaint is their inability to change lenses, limiting them optically. This simple learn will show you how to turn an unused smartphone into a perfectly serviceable video surveillance tool.

Text by *Marcus Wong*

## MORE INSIDE >

- FERRY A VIP LIKE A PROFESSIONAL
- TURBO BOOSTING YOUR GALAXY S6
- KNOWING YOUR LCD PANELS



# SMARTPHONE TO SPY PHONE



Need to infiltrate and collect intel from an office or classroom?

There's actually a highly sophisticated tool you already have that can do just that – the humble smartphone. Today's smartphones are all very capable image-taking devices, able to produce fantastic stills and video. Add to that the innate data transmitting capabilities, and you have a ready-made surveillance camera in your pocket that no one will suspect!

## SWITCH IT UP

To add a different field of view to the camera, simply attach clip-on lenses like what's available from Inmacus to your smartphone. These range from wide-angle attachments to circular polarizers to macro filters that let you get physically closer to your subject and thus get more detail. With these, your smartphone can get snaps of anything from confidential information on microfilms to plans for world domination sprawled across the walls.



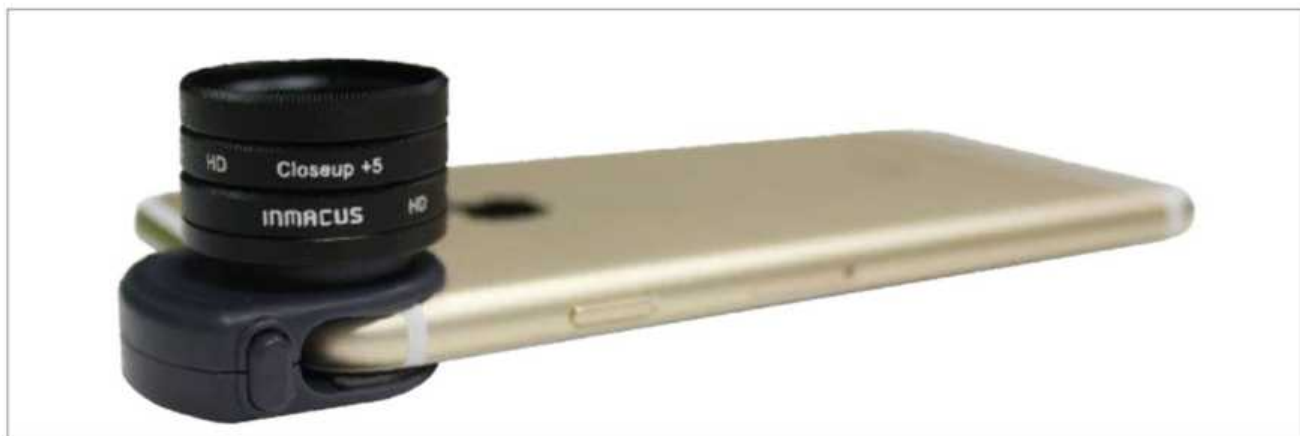
The 18mm Wide lens brings a 50% wider view.



Close-up filters lower the min. focusing distance.



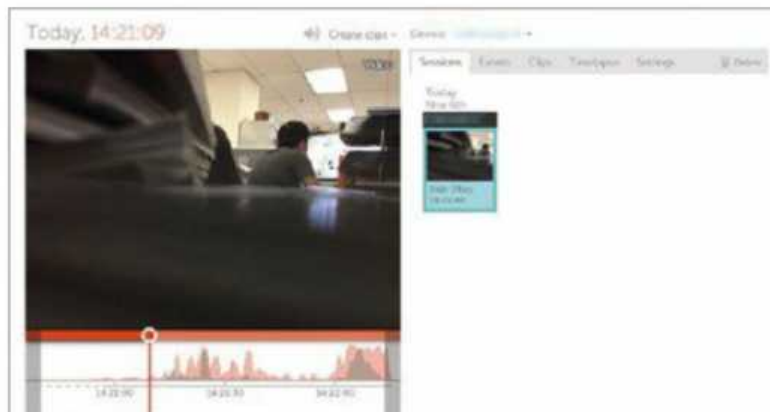
You can stack close-up filters to get even closer.



Even when you stack all three lenses, the overall profile remains fairly small.

## SET IT UP

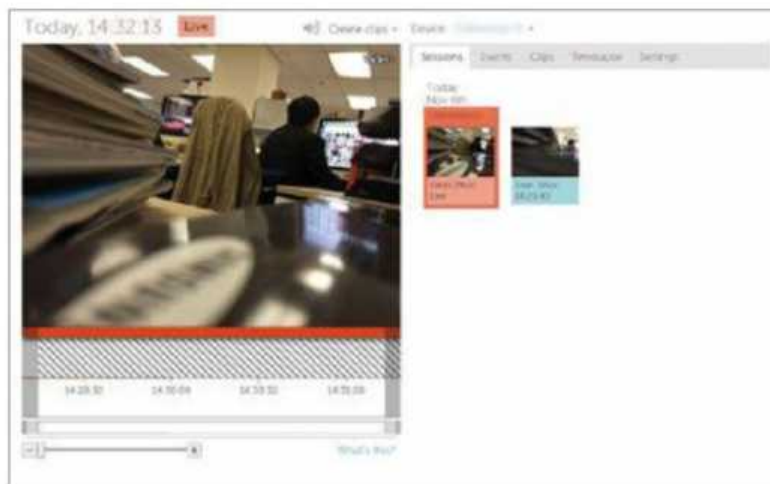
First, get an app that can tap into the video recording capabilities of your smartphone. For iOS devices (the Android version is still in Beta), we like the Manything app. This little app allows you to remotely control the camera of your smartphone via their website as long as the app is running and your smartphone is connected to a network.



You have options to start/stop video recording, change to stills mode, mute audio and switch between front or rear camera; all from a private log-in area on the site. Set the motion sensitivity levels and detection zones on the app, and it will automatically send you alerts when your smartphone's camera detects any movement in its field of view.



Otherwise, just set the app and use it to turn on the camera in video mode to get a real-time visual feed of what's going on. You'll probably want to find a way to also run a cable to the nearest workstation so it doesn't run out of juice.



## LEAVE IT OUT

After that, it's just a question of finding the best spot to place the phone, and finding a way to prop it up properly. In this case, the older, smaller smartphones are probably a better bet as they are smaller and probably would draw less attention if they were left unattended (in an empty coffee cup, for example). We'd recommend just using good old Blu-tack to hold them up, though for the ultimate in covert operations, you can always do what the real spies do and cut through a stack of files to hide your phone.

### HERE ARE SOME OTHER OPTIONS FOR APPS THAT WILL ALLOW YOUR MOBILE PHONE TO STREAM VIDEO FOR BOTH IOS AND ANDROID:



**Presence**  
(Free, iOS and Android)  
Just like Manything, Presence allows you to turn your smart phone or tablet into a security

camera and motion detector using the camera. You can also sign in from another mobile device or the web to remotely monitor an area, but Presence adds the option of allowing multiple users to connect to a single camera.



**IP Webcam**  
(Free, Android only)  
An Android only option, IP Webcam lets you view your camera from a web browser or via

VLC, one of the most commonly used video players across platforms. What's interesting is that IP Webcam supports direct streaming over Wi-Fi without the need for internet access, and there's the option for two-way audio via the tinyCam Monitor function.



**Alfred** (Free, Android only for now; iOS version still in development)

Alfred bills itself as being "easy to use" and "always ready", allowing you to get your video within 1-3 seconds even if you're using a mobile connection. It supports multiple viewers and multiple webcams, and even adjusts the quality of your video feed to match your network speed for clearer images and lag-free streaming.

# MAKE YOUR SAMSUNG GALAXY S6 AND S6 EDGE RUN FASTER

by Koh Wanzi

You've heard about overclocking your PC, but how about overclocking your phone? Android is best known for its open-sourced nature, which means that third-party developers are able to chime in with things like custom kernels – the core of any operating system that mediates requests between software and hardware – to enable performance boosting. If that sounds like something you'd like to experiment with but you're afraid of frying your phone, fret not. Here's a fairly easy and safe way to squeeze more performance out of your Samsung Galaxy S6.

There's just one caveat – this guide is primarily for people who have some background in tinkering with Android. You should at the very least already have a rooted device, a custom recovery installed, and know your way around the latter. But to ensure we're on the same page, we recommend CF-Auto-Root to gain root access and TWRP v2.8.7.1 recovery.



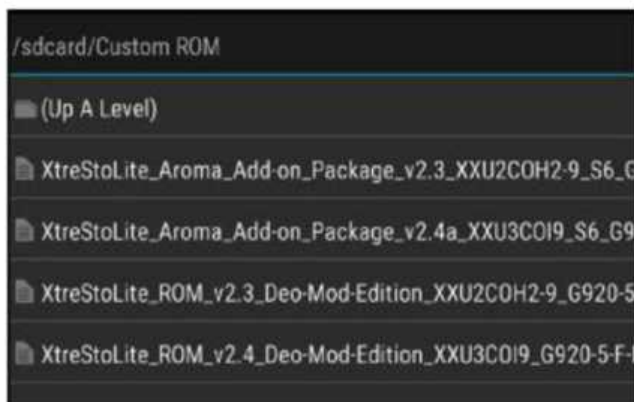
## 1. INSTALL A CUSTOM ROM

It's time to ditch that stock Samsung ROM. You'll want to download XtreStoLite Deo-Mod Edition 2.4 and its Aroma Add-On Package from the Galaxy S6 XDA forums. This is essentially based on Samsung's stock files (which means it should be very stable), but with all the custom software stripped out.

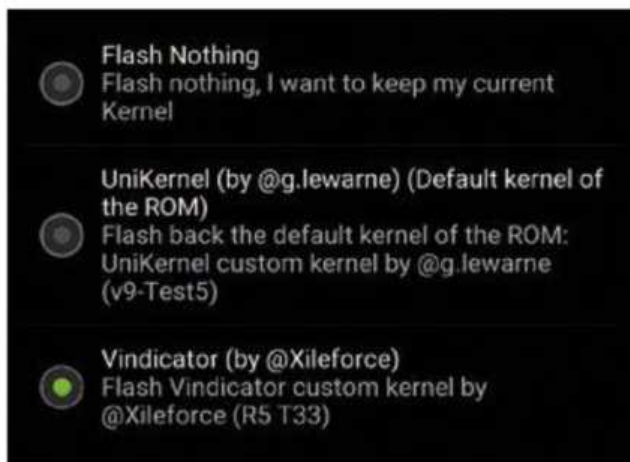
Put both .zip files on your phone and then boot into recovery mode (Power + Home + Volume Up buttons). Next, hit "Wipe" in the tiled menu and work the slider to factory reset your phone. After that, tap "Advanced Wipe" and check the Dalvik Cache, Cache, and System options, and swipe to wipe those components.



Now you're all set to flash the ROM. Return to the main menu and hit "Install". Navigate to the folder where you placed the ROM, select the right file, and then swipe to flash. After you're done, do the same for the Aroma Add-On Package.



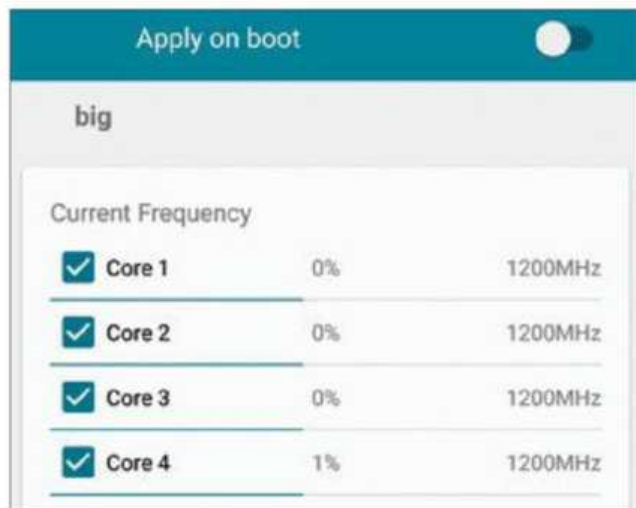
This time, pay closer attention to the installation menu. You'll be prompted to select one of two custom kernels. Select "Vindicator", and continue on with the installation. When that's finished, you can reboot the device.



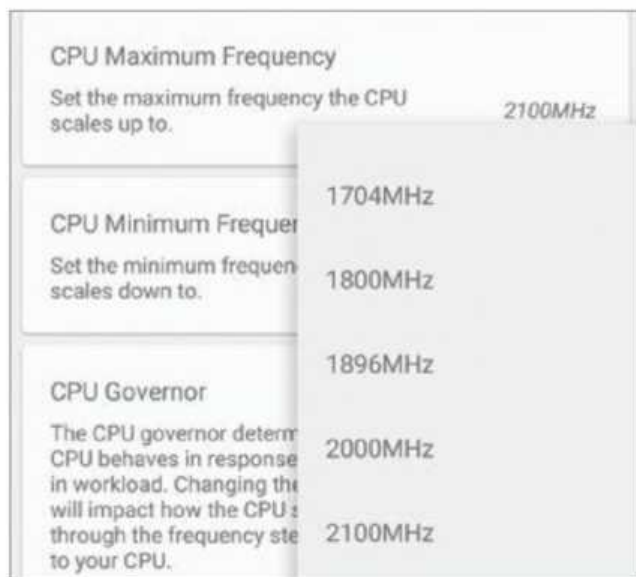


## 2. DOWNLOAD KERNEL ADIUTOR AND SYNAPSE FROM THE PLAY STORE

Kernel Adiutor will let you view the clock speeds of all the individual cores on your eight-core Exynos 7420 CPU. The “big” cores refer to the 2.1GHz Cortex A57 cores, while the “LITTLE” cores are the 1.5GHz Cortex A53 cores.



Increasing the minimum frequency of the CPU will result in less performance slowdowns, while increasing the maximum will allow the CPU to ramp higher under loads such as gaming. The drop-down menu offers fixed overclocked values, which simplifies things by limiting your options. We were generally comfortable going for a maximum frequency of 2,304MHz for our device.



You can tweak the same parameters for the more power-efficient Cortex A53 cores as well. Less demanding tasks like web browsing will prioritize these cores over the A57s, so if you think your phone could be speedier in this area, overclocking these cores may help.

For voltage control, use the Synapse app to set the voltages for the individual CPU steps. In general, lower clock speeds (< 1,000MHz) could do with around a 25mV undervolt to conserve power. Synapse computes the increased voltage at the overclocked frequencies for you, and we didn't see a need to deviate from those values. But if your overclock is unstable, boosting the voltages slightly may help.



## 3. TWEAKING THE CPU GOVERNOR

Kernel Adiutor also lets you change the CPU governor for both big and LITTLE core clusters. This is what controls how the various cores respond to changes in user demand. There are just two options to choose from here: interactive and performance.

The default interactive governor dynamically scales CPU clock speeds in response to user workloads. It is also capable of utilizing intermediate CPU frequencies, which makes it a fairly versatile governor that balances both performance and battery life.

On the other hand, the performance governor simply locks the phone's CPU at maximum frequency. If you're going to want to do this at all, it makes more sense to apply this for the LITTLE cores as you'll get faster general performance while not quite draining your battery with the more power-hungry big cores.

The Governor Tunables option is not available for the performance governor, but you have the option to further tweak the interactive governor. The options may seem a lot to grapple with, but you can just pay attention to the following (along with tips as to what they do):

- **hispeed\_freq** - CPU frequency (in Hz) to bump to when CPU load above go\_hispeed\_load. Increasing this boosts performance.
- **go\_hispeed\_load** - Go to hi speed when CPU load is at or above this value. Lowering this value will cause the CPU to ramp up more often, and vice versa.
- **min\_sample\_time** - The minimum amount of time (in  $\mu$ s) to spend at a frequency before CPU can ramp down. Increasing this value increases the number of successive tasks you can perform before the CPU scales back down, reducing frequency bouncing.
- **timer\_rate** - Sample rate (in  $\mu$ s) for reevaluating CPU load when system is not idle. Decreasing this value may allow CPU to respond to sudden loads more quickly.



# HOW TO FERRY A VIP LIKE THE SECRET SERVICE

by *Kenny Yeo*

You've always wanted to be a spy or have a job that sometimes involves transporting objects or even individuals of high worth. But as we all know, this is the time when you are at your most vulnerable. Lots of things could go wrong as you move from point A to B, and it's hard to keep your eyes on the package and on the road at the same time. So how do some of the most highly trained professionals in the world do it?

## 1. THE CAR

Picking the right car is winning half the battle. The popular notion is to drive something that is heavily armored. President Obama's presidential car, for example, is protected by 8-inch thick doors and is strong enough to withstand gunfire, bombs and grenades. However, not everyone is likely to have that kind of luxury. And the best car for the job is in fact the most common car you can find in your area of operation. So if your job brings you to Singapore, your car of choice should be the Mercedes-Benz E-Class - Singapore's best-selling car.

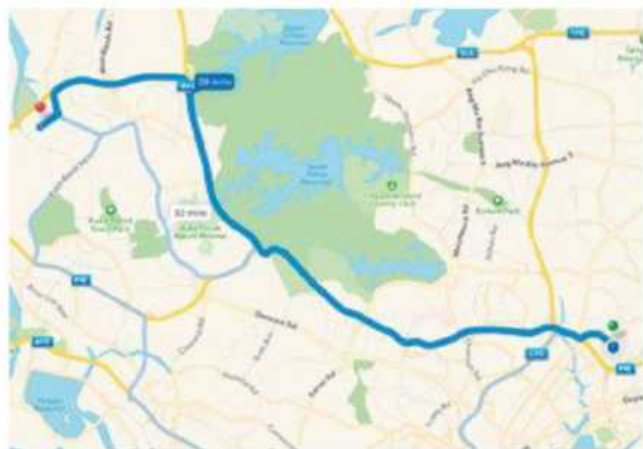
The reason is to blend in. For the most part, the massive limousines that you see used to transport VIPs are all for show. While that is all happening, the VIP is usually sneaked off in a much more discreet car. Pick a common car that you see in the area so that it won't attract attention and people won't even bother to take a close look at it. Of course, pick something that's fairly maneuverable too - use common sense.



## 2. PLAN YOUR ROUTE

If you have been lucky enough to have the luxury of time, plan your route. Failing to plan is planning to fail. Also run through the entire route on the day before the operation. Scout the road for potential hazards and take note of how the traffic flows. If there's a traffic jam, think about how you can minimize the time stuck in traffic. What's the cause of the job? Is there a safe alternative route? How are the cars lining up? Pay attention to junctions and look out for possible sources of attacks.

And on the actual day, take note of the things you saw and see if there's anything along the route unusual from the day before; a sudden roadwork zone or a police stop zone. Pay attention to the construction tent; is there something inside that shouldn't be there? And if there are police, see if they are real policemen.



## 3. WHAT TO DO IF YOU ARE BEING FOLLOWED?

Is your spider sense tingling? Do you feel like you are being followed? Keep calm. In the movies, you often see the target speeding up and then swerve through traffic like a mad man. Well, according to professionals, that's just dumb. Why would you need to go so fast? It just makes things easier for the people that are trying to follow you, as they will be able to spot you easier. Additionally, going fast to the point where you are disregarding traffic rules just makes you more likely to get into an accident yourself.

Instead, the right thing to do is to keep going and look for an opportune moment to execute a very abrupt 180-degree turn. Next, pay attention to see if anyone is doing the same. If they are, move to the side and slow down. This puts you in the upper hand, as the car following you cannot slow down now as well otherwise it would be too obvious. Now, allow it to pass and observe what the car is trying to do.

## 4. OK, IT'S OBVIOUSLY FOLLOWING ME. WHAT DO I DO NOW?

Keep calm. The priority now is to stay safe and one way to do that is to ensure you're being seen by others. If you are near or in the city, head into the city center where there's lots of people and traffic. And if you have to depend on a GPS, never set it to go the shortest way because that will take you onto small roads. Set it for the fastest route and stick to the highways.

## 5. HOW DO I TAKE EVASIVE ACTION?

It's common sense, but whatever you do, do not crash. This is also why it is not advisable to drive at excessive speeds, keep to a moderate speed of around 100km/h so that you can still maintain reasonable control of your car. But if your car is clearly faster, you can always just outrun your pursuer.

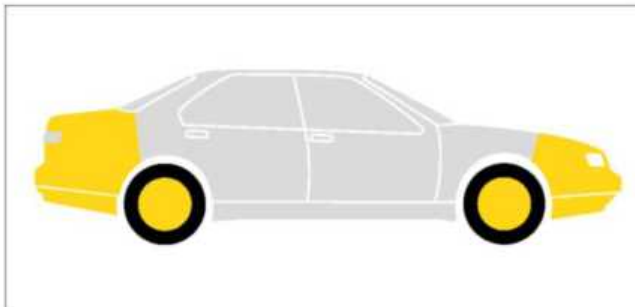
Another rule to note is never let your pursuer pull up alongside you. When they are alongside, you become an easy target. When they are alongside, they might also attempt to force you off road. Hence, ensures your sides are blocked by driving next to something else. It can be another car, the pavement, railings, trees or whatever. The idea is to make it hard for them to come up alongside you.



## 6. HOW DO I RUN SOMEONE OFF THE ROAD?

Things have gone south and your attacker is hot on your tails now and no matter what you do, you can't shake them off. Now it's time to go on the offensive and try to get them off the road. The basic rules of dogfighting applies, you need to get them ahead of you. To do that, look for an opportunity to hit the brakes so that they will pass you. If you can get them ahead of you, your task will be considerably easier.

What you want to do is to rush straight for your attacker's rear wheel section. You want to hit it or push it, so be sure to be traveling around 20km/h to 30km/h faster than your attacker is. Immediately after impact, hit the brakes and counter-steer your car to break contact. Hitting the rear wheels will cause the car to break traction and skid, which could cause him to go off road or even crash.



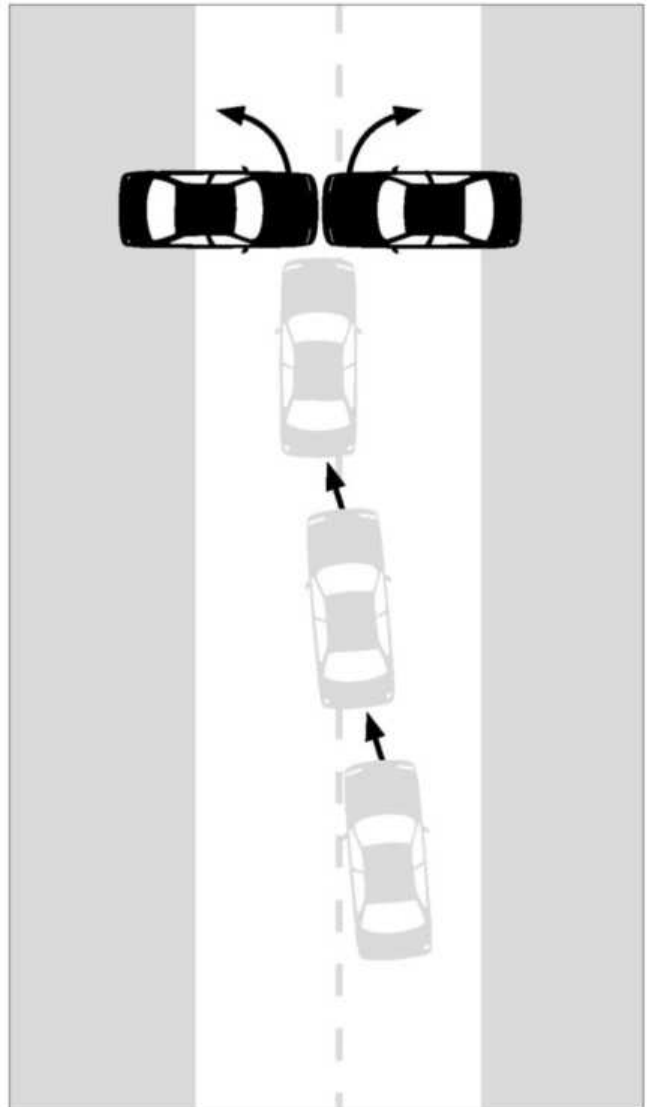
## 7. DRAT, THERE'S A ROADBLOCK. NOW WHAT?

Roadblocks are an extremely effective way of trying to stop a getaway vehicle and you must prepare yourself that you might encounter one. The ideal way to deal with roadblocks is to find a way around it or head back the way you came from. The reason is because ramming a roadblock should be viewed as a last ditch resort as you risk damaging your car in the ramming process. However, if you are left with no choice, this is what you can do.

Slow down as you approach the roadblock and put the car in a low gear. You need the torque and momentum to be able to successfully ram through the roadblock. It can also throw off your attackers by giving them the illusion that you are surrendering. Now pick a spot to ram your car through and commit to it by flooring the accelerator.

Always aim for the ends of the car, the rear is most preferable as it will allow the blocking car to swing out of the way more easily. Never aim for the middle as that is often the strongest part of the car.

Your speed at impact should be between 25km/h to 50km/h. After you have successfully rammed through the roadblock, keep going regardless of how badly damaged your car might be. Good luck.





# KNOW THY PANEL

by Salehuddin Husin

Buying a monitor is not simply just walking into a store, choosing one and then simply walking out. Well you can do that, but the results might be spectacularly weird. Instead, we recommend taking the time to learn the most common types of LCD panels that are available so you can get one just right for your needs.

## TN PANELS:

TN (Twisted Nematic) displays are the most widely used panel type displays that make use of LCD technology. Being cheap and inexpensive to make, they are suited for fast paced gaming, as in games like Counter-Strike and Call of Duty.

Unlike other panels, TN displays have rather snappy response times. The response times of current TN panels range from 1ms to 5ms. There are normally two values for response times, BTB (Black-To-Black) or GTG (Grey-To-Grey). Response time measures the time taken for a pixel to go from black to white and back to black again (or grey in the case of GTG). Faster response times reduce the effects of ghosting in fast-moving scenes of movies and especially video games. Modern TN panels can also have a fast refresh rate, up to 120Hz and even 144Hz, which makes them suitable for 3D content.

TN displays' weaknesses are that they have the worst color reproduction, low viewing angles (under 170-degrees) and contrast ratios of any LCD panel technology. Unlike most 8-bit IPS/VA based panels, TN is only 6-bit, which makes them unable to display a full 24-bit depth, 16.7 million color palette. While they can mimic the 16.7 million colors of 8-bit panels (through a process called dithering), the results aren't particularly impressive or noteworthy.

**Who is it for:** TN panels are the cheapest of the lot, so they're usually the go-to monitor for those on a budget. However, gamers actually benefit the most from the speedy response times as color quality and viewing angles normally come second to a monitor's ability to keep up with the high frame rates and fast-paced actions of modern games.



The ASUS MG278Q is an example of a TN type display.

PICTURES ASUS, BENQ, ACER



The BenQ XR3501 is an example of a VA display.

### VA PANELS:

VA (Vertical Alignment) panels are the middle option in LCD panels. They were originally designed to offer better color reproduction and wider viewing angles (up to 178-degrees) than TN displays, and faster response than IPS. They're main strength is in better blacks and higher contrast ratios compared to other display types. This makes VA panels good for video playback and movie watching.

However, because of the way VA panels are designed, they have an inherent flaw that's known as color shifting. Color shifting is when an image viewed from different angles appears to change position when view from another angle, due to uneven brightness levels. The color shifting also has another side effect in that shadow details are lost in dark scenes, especially when field from the

center.

Also, while other display types (TN and IPS) have progressed to address their initial flaws, VA panels haven't really been able to keep up. Primarily, it's one of the slower panels around, with average response times in the ballpark of 8-16ms.

**Who is it for:** VA panels were originally the choice for those who wanted a better multimedia experience since it produced greater blacks, which is good for movies. It is also considered an upgrade over TN panels for most general tasks except gaming. However, as both TN and IPS technologies have caught up, many companies have reduced support for VA-type panels.

### IPS PANELS:

IPS (In-Plane Switching) panels are generally considered the best overall LCD technology today. Among the LCD panels, IPS panels usually have the best image quality, the greatest color accuracy and robust viewing angles. Due to this, graphic designers, photographers, or other professionals that rely on accurate color reproduction will normally choose such displays.

They also offer 178-degree viewing angles like VA panels, but actually achieves close to this spec with very little to no distortion in image or color quality both vertically and horizontally. They also do not exhibit the type of contrast-shift that VA panels suffer from.

Original IPS panels had lower response times that could go up to 16ms, making them not-suitable for moving content such as videos and gaming. However, improvements to IPS technology such as H-IPS (Horizontal In-Plane Switching) reduced the gap somewhat. Today's IPS panels can offer as low as 5ms GTG response times. Over the years, IPS has seen the most development. Besides H-IPS, there is p-IPS (Performance IPS) with 10-bit color support, AH-IPS (Advanced High-performance IPS) with increased resolution and pixel density.

Some proprietary panels such as Samsung's PLS (Plane-to-Line Switching), which is meant to compete with IPS, is based on similar concepts. Today, most ultra-high resolution screens such as Apple's Retina displays and high-ppi mobile screens are IPS panels.



The Acer XB270HU is an example of a monitor with IPS panel.

**Who is it for:** Originally intended for color-critical work such as graphics design, modern IPS screens are fast enough for gaming and prices have gone down enough for everyday general usage.

# THE FORCE AWAKENS

by Koh Wanzai

Not too long ago and in this particular galaxy, Star Wars: The Force Awakens hit the theatres. And while we're still patiently waiting for the lightsaber to be invented, there's still a lot you can do in the meantime to slake your thirst for all things Star Wars. Here is a selection of apps to help you immerse yourself in the Star Wars universe and countdown the days till Episode VIII.



## STAR WARS: COMMANDER

iOS, Android, Windows Phone  
Free



This Clash of the Clans-style game allows you to choose between the Rebellion or the Empire

and battle alongside iconic characters like Darth Vader, Luke Skywalker, and Han Solo. Forget about taking over the world – the entire galaxy is up for grabs here! Various planets from the Star Wars universe are featured, and you'll be able to relocate your home base to worlds as varied as Yavin 4 and the ice world of Hoth. AT-ATs, wookies, and stormtroopers all join together in epic combat, and you can even team up with friends to battle for your heroic – or nefarious – ends.

## STAR WARS

iOS, Android  
Free



The official Star Wars app is the go-to app for the diehard Star Wars fan. With breaking news, social media

updates, and other interactive features, it is a rich repository for all things pertaining to that galaxy far, far away. Learn about the latest Star Wars digital apps and products and receive instant notifications for movie and trailer releases. It has an augmented reality feature that lets you take a selfie as one of your favorite Star Wars characters. What's more, there's a collection of classic quotes and sound effects from the movies, like the sound of a lightsaber powering up and R2-D2's signature trill.

## STAR WARS: UPRISING

iOS, Android  
Free



Set between Return of the Jedi and The Force Awakens, this RPG game lets you create

your own hero with your own custom set of abilities and gear. Massive Sector Battles will put the expansion of in-game content – like new planets, exclusive gear, and level caps – in the hands of you and your fellow players. You could also team up with friends and form powerful alliances to explore the dynamic world and take on seemingly unstoppable bosses. Everything happens in real-time, so the world is always changing and player actions can make all the difference.

## STAR WARS SCENE MAKER

iOS  
Free



This app lets you exercise your creative chops in stitching together your own take of scenes in the Star

Wars universe. You get to play director here and choose from a variety of settings, characters and weapons. But it doesn't stop there, and you can control all the action, add the dialog, and even select the soundtrack. Three in-app virtual cameras allow you to record the scene from multiple angles, and if the film dialog isn't to your liking, you can record your own voice and put it in any character's mouth. So if you always fancied seeing Darth Vader fight alongside Luke Skywalker, you can make it happen now.



This Clash of the Clans-style game lets you build up your own base.



Take a selfie as one of your favorite Star Wars characters.



Form an alliance with friends to take on more powerful enemies.



Shoot from multiple camera angles and add your own custom dialog.



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The Game Boy Color (1998) was the last iteration of the iconic Game Boy console. It was succeeded shortly by the Game Boy Advance before giving way to the Nintendo DS in 2004.



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